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Ground and Project CONSULTANTS LTD

Chipping

Slope Stability Report

July 2022

Hodson Homes Ltd

20 Wood Beech Gardens

Clayton-Le-Woods

Chorley

England

PR2 2YH

Draft Report

Report No. 80783

Document Verification

Prepared for	Prepared by
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Report Number	Revision	Date	Comments
80783	0	20/6/2022	Draft
80783	1	20/7/2022	Final

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Executive Summary

Site Location	The site is located in the northeast of the village Chipping.
Coordinates	SD 62048 43499
Proposals	The proposals for the site include the development of four residential properties. The design will include the reworking of the present slope to allow for gardens to the north.
Scope of Services	Geotechnical Assessment, Slope Stability Assessment
Site Description	The site is on a hill at a maximum elevation of approximately 130m AOD. The site steeply slopes to the north and gently to the south and east.
Site History	The site has previously been unused. A structure named Malt Kiln House has been present to the east of the site from 1890's OS Mapping.
Anticipated Ground Conditions	BGS mapping indicates the geology to comprise of Till (Glacial Deposits), overlying Park Style Limestone Member (packstones and wackestones interbedded with fissile and blocky mudstone). Alluvium is mapped to the northern boundary of the site. The ground conditions encountered during the 2019 Ground Investigation indicate Topsoil to between 0.2m and 0.8m bgl, overlying Glacial Deposits comprising cohesive and granular material to depths of up to 4m bgl.
Slope Stability Assessment	Slope stability analyses indicate the existing site configuration to be potentially unstable. Some evidence of movement has been observed. The proposed site works, including cut and fill, indicates potential instability in the proposed slope configuration.
Recommendations	It is recommended that the proposed slope is re-designed to achieve a satisfactory utilisation. Further ground investigation is recommended to provide more geotechnical understanding of the subsurface.

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Tables and Figures

Appendices

1 Introduction

Ground and Project Consultants Ltd (GPCL) has been instructed by Hodson Homes to undertake a Phase II Geotechnical Assessment at Chipping. The proposals for the site comprise four residential properties.

The objectives of this report are to ascertain the expected ground conditions at the site and to assess the implications on the proposed development.

The scope of this report and approach are as follows:

- A review of the existing data supplied by the Client:
  - Phase II Geo-environmental Site Assessment by E3P (Report Ref: 12-424). Dated May 2018.
- Summarise the pertinent geology, hydrology, and hydrogeology,
- Summarise the ground investigation including window sampling boreholes and trial pits,
- Development of a ground model that summarises ground investigation data, develop characteristic values for the strata at site and highlight any uncertainties,
- Slope stability analysis of the original and proposed slope profiles with later modifications to slope profiles,
- Provide preliminary remediation options.

2 Site Information

The information on the site and surrounding area has been obtained from freely available sources included in the references in Section 5. Where appropriate, figures and tables have been provided throughout the report for ease of assessment.

2.1 Site Location

The site is located in the northeast of the village Chipping at Grid Reference SD 62048 43499. The site address is (Parcel 4) Land North of Church Raike, Chipping, Preston, PR3 2QL.

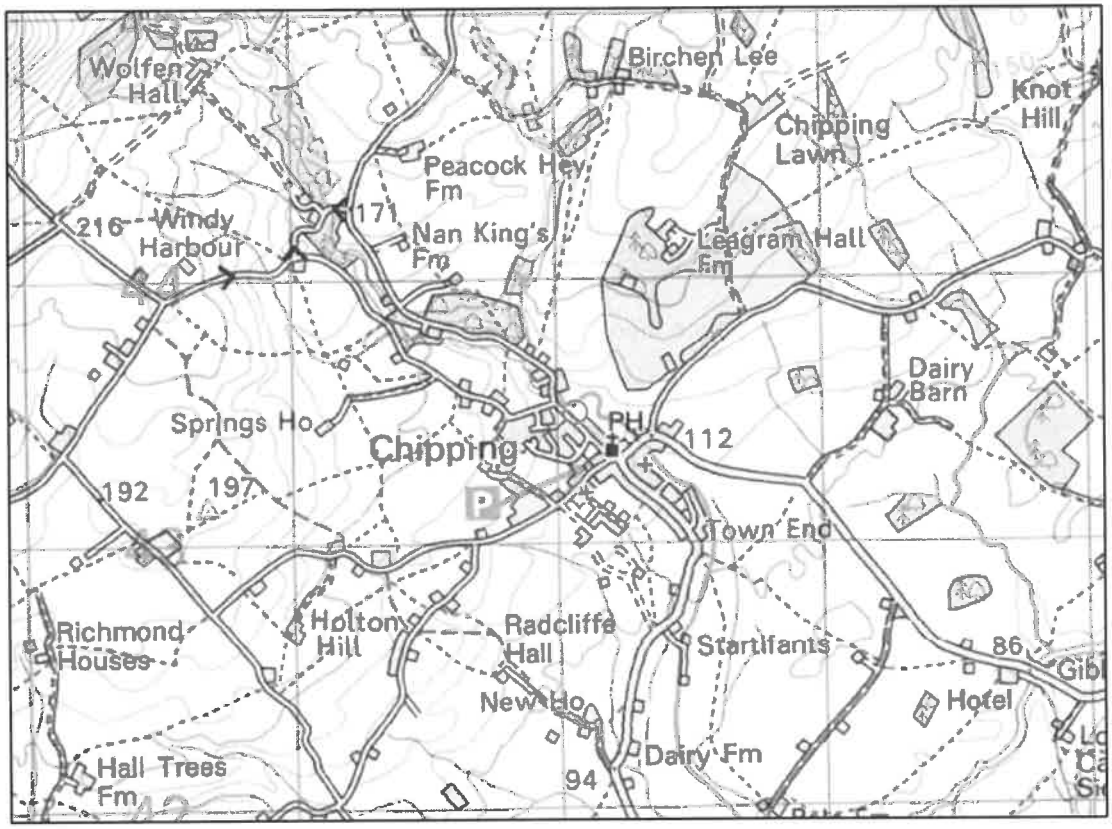


Figure 1: Site Location and Topography (Ordnance Survey, copyright 2022)

The site is on a hill at a maximum elevation of approximately 130m AOD. The site steeply slopes to the north with overall gradient of 27°. The site gently slopes to the southeast with an overall gradient 8°.

2.2 Proposals

The proposals for the site include four residential properties and garden space. The houses are proposed to roughly sit on the crest of the slope with gardens to the north. The proposed Site Plan by Hodson Homes (Drawing No. MKB/SP01) indicates the proposed floor levels to be between 127.15m and 128.65m AOD. Site access is to be from the south via Church Raike.

2.3 Geology

The geology of the site is indicated on BGS Sheet 67 (Garstang) and the BGS Viewer. An extract of the geological map is included in Figure 2 below.

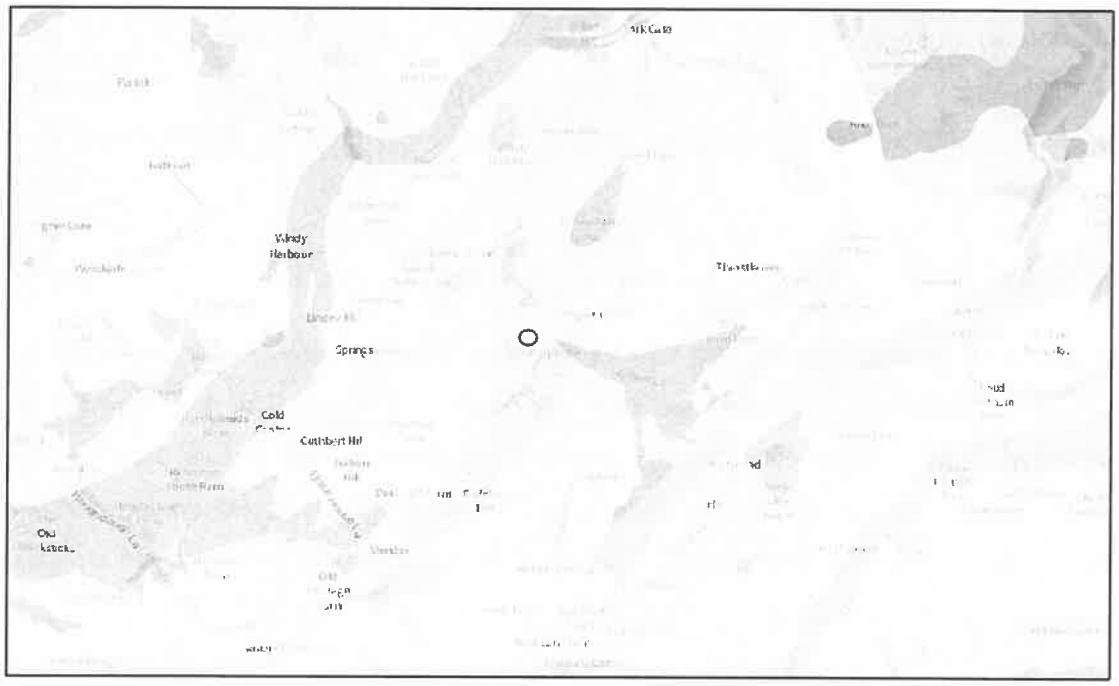


Figure 2: Geology (BGS Viewer)

BGS map indicates the geology to consist of Till (Glacial Deposits), overlying Park Style Limestone Member (packstones and wackestones interbedded with fissile and blocky mudstone). Alluvium (clay, silt, sand and gravel) is mapped to the northern boundary of the site, at the location of the Chipping Brook, which borders the site.

The site is indicated to be in a Radon risk zone, with 10-30% of properties within the 1km grid being above the action level.

2.4 Hydrology and Hydrogeology

The closest surface water feature includes a watercourse on site towards the south running west to east. The nearest major hydrology feature to the site is the Chipping Brook which borders the site to the northwest and runs west to east.

The site is in a Flood Risk Zone 1 Area, indicating a low probability of flooding. However, a Flood Risk Zone 3 Area is located directly to the north and northeast of the site, associated with the Chipping Brook. According to government open-source data, the site itself is in a high-risk area from surface water and very low risk from rivers and the sea. This is likely due to its proximity to the Chipping Brook, however, the site lies approximately 10m above the level of the stream.

The Glacial Deposits are characterised as Secondary (undifferentiated) Aquifer by BGS hydrogeological mapping. The Bowland High Group (encompassing Park Style Limestone Member) is characterised as Secondary A Aquifer. There are no groundwater abstractions in the vicinity of the site.

2.5 Site History

Ordnance survey mapping from 1844-1847 indicate the site to be unused. Off-site developments include Chipping Factory 130m to the north of the site, a corn and flour mill 350m to the southeast, a brick house 600m to the southeast and Saunder Rake Factory 640m to the northwest. The wider area experienced limestone quarrying which was discontinued from 1910-1913 mapping. By 1949-1958 maps, the village of Chipping was further developed and has continued to expand by the 2022 mapping.

Table 1: Site History

Date	On site	Off site
1844-1847	No developments on site.	Chipping Factory 130m north. Limestone Quarry 1km southwest. Saunder Rake Factory 640m northwest. Brick House 600m southeast. Corn and flour Mill 350m southeast.
1892	A structure to the east of the site mapped as Malt Kiln House.	No significant changes.
1910-1913	No significant changes.	Limestone quarry now indicated to be Old Quarries.
1949-1958	No significant changes.	Housing development to the south of Church Raike present. Unspecified Works indicated approximately 180m north.

2022	No significant changes.	Significant development of Chipping village to the south-east of the site..

The E3P Geo-environmental Report indicates there to be no past or current contaminative land uses within 250m of the site.

The freely available Zetica UXO risk maps indicate the site to be located within a low-risk zone.

3 Ground Investigation

3.1 Fieldwork and Laboratory Testing

The ground investigation works undertaken by E3P Ltd on 18th and 19th April 2019. The scope of the ground investigation comprised:

- 9 No. window sampling borehole to depths of between 1.45m and 4.45m bgl (3 No. installed for ground gas and groundwater monitoring),
- 8 No. mechanically excavated trial pits,
- 2 No. dynamic probe tests to depths of between 7m and 13m bgl.

Eleven samples were sent for a generic suite of common contaminants including metals, cyanide, polycyclic aromatic hydrocarbons (PAHs), Total Petroleum Hydrocarbon Criteria Working Group (TPH CWG), VOCs, SVOCs, and an asbestos screen.

Two dry density and moisture content tests, and two particle size distribution (PSD) tests were carried on the natural soils as part of the geotechnical testing. In addition, ten BRE SD1 sulphate tests were carried out.

3.2 Ground Model

A ground model has been developed by assessing the available data and is detailed below.

Table 2: Summary of Ground Conditions

Strata		Description	Depth to base of strata (m bgl)	SPT N Values
Topsoil/ Made Ground		Brown slightly sandy clayey GRAVEL with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.	0.2-0.8	n/a
Glacial Deposits	Clay	Soft to stiff yellow brown sandy gravelly CLAY with pockets of yellow orange sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.	0.8-3.0	n/a

	Gravel	Medium dense to very dense brown black sandy clayey silty GRAVEL. Gravel is fine to coarse angular to rounded of mudstone, sandstone and limestone. Occasional pockets of orange fine to medium sand.	1.0- >4.0	13-50

3.2.1 Topsoil

Topsoil was encountered as slightly sandy clayey gravel with rootlets and pockets of fine to medium sand. Gravel was observed as fine to coarse angular to rounded sandstone and mudstone.

3.2.2 Glacial Deposits

The Glacial Deposits were encountered as variable materials, including clays and gravels. Deposits were encountered as soft to stiff sandy gravelly clay. Gravel was described as fine to coarse angular to rounded mudstone and sandstone. The clay deposits were primarily encountered to the west of the site, in the uphill area overlying the lower gravels.

Most of the Glacial Deposits on site were encountered as medium dense to very dense sandy clayey silty gravel. Gravel was described as fine to coarse angular to rounded mudstone, sandstone and limestone.

SPT N values within the gravels were recorded between 13 and 50 (medium dense to very dense), generally increasing with depth (See Appendix B).

The maximum dry density of two samples of gravel were between 1.97 and 2.00 Mg/m^3 and the optimum moisture content (OMC) was determined to be 10% for both samples. The initial moisture content of the samples was 10%, indicating that the samples were both at their OMC.

3.3 Groundwater and Ground Gas

Groundwater was encountered in TP107 and TP108 at depths between 0.9 and 2.0m bgl within the gravels. The groundwater was noted to be slow seepages.

During groundwater monitoring visits, all installations were found to be dry.

The E3P Geo-environmental Report indicates the risk from ground gas to be very low and the site having a Gas Screening Characteristic Situation 1.

3.4 Soil Parameters

From the above information the soil parameters used in the analyses are shown in the table below.

Table 3: Summary of Soil Parameters

Soil Parameters		Unit weight of unsaturated soil	Unit weight of saturated soil	Angle of internal friction	Effective cohesion
Units		kN/m³	kN/m³	°	kPa
Glacial Deposits	Clay – soft	19	19	26	2
	Clay - stiff	20	20	28	2
	Gravel	20	21	35	1

It should be borne in mind when designing, constructing and excavating that ground conditions can vary rapidly both laterally and vertically.

4 Slope Stability Assessment

4.1 Assessment of existing slopes

The analyses have used a topographical survey (Drawing No. MKB/SP01) and exploratory holes. During the site walkover in May 2022, some instability was observed. Evidence of movement of the slope was noticed as a scarp towards the top of slope, in the centre of the site (see Appendix A).

Three cross sections have been developed crossing the northern slope leading towards Chipping Brook, see lines of section labelled on the drawing within Appendix A. The slope stability analyses have considered the existing site configuration and the proposed configuration.

GPCL has carried out slope analyses using Geo5 Slope Stability software using Design Approach 1 as per EC7. Bishop's method of circular analysis and Sarma's method of polygonal analysis have been used. The analyses have used and investigated conservative parameters in the slope assessments, recorded in Section 3.4. These parameters were determined from the back analysis of the slope (assuming a current factor of safety of 1) and supported by the limited geotechnical testing.

Table 4: Slope Utilisation

Section	Overall slope angle (°)	Utilisation (%)	Failure Mode
A-A' (existing configuration)	27	107.6	Circular
		105.1	Noncircular
B-B' (existing configuration)	27	121.9	Circular
		99.6	Noncircular
C-C' (existing configuration)	24	93.5	Circular
		87.3	Noncircular

The results of the slope stability assessment indicate the existing site slope configuration with overall angles of 24°-27° to be potentially unstable. Sections A and B were found to have utilisations exceeding 100%. Section C was found to be at a shallower angle and gave utilisations below 100%. The failure plane is observed to be shallow, occurring generally in the top 2m of

the ground. The determination of instability reflects the back analysis and the presence of the shallow failure.

4.2. Remediation Optioneering

Based on the site observations and the slope stability assessment described above, the proposed slope does not have adequate factor of safety and has been exhibiting signs of instability. Some potential solutions have been briefly developed in the Geo5 software.

An embedded retaining wall may be an appropriate solution to stabilise the slope and create a level garden area. An indicative embedded retaining wall solution is presented in Figure 3 below.

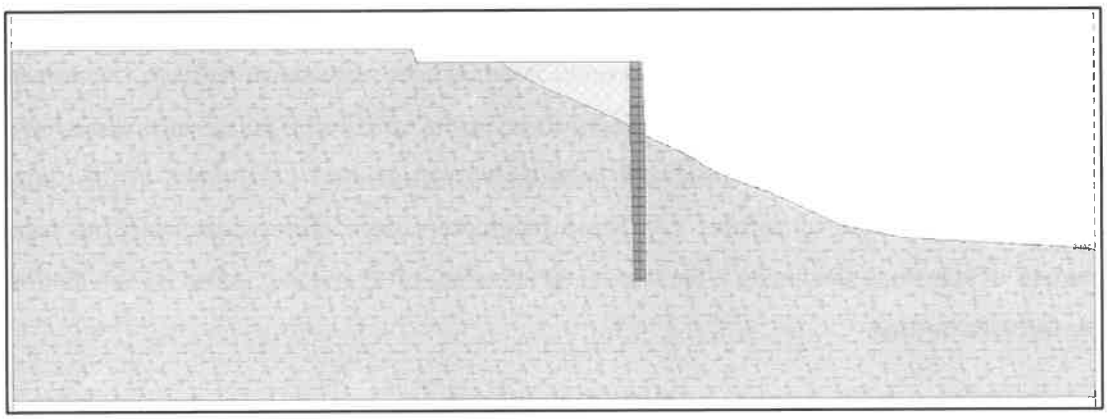


Figure 3: Embedded Retaining Wall Example

An alternative approach to be considered is the reinforcement of the infilled slope material via geogrids. An analysis of Sections B and C with 1m spaced geogrids indicated stability. This potential configuration is presented in Figure 4 below.

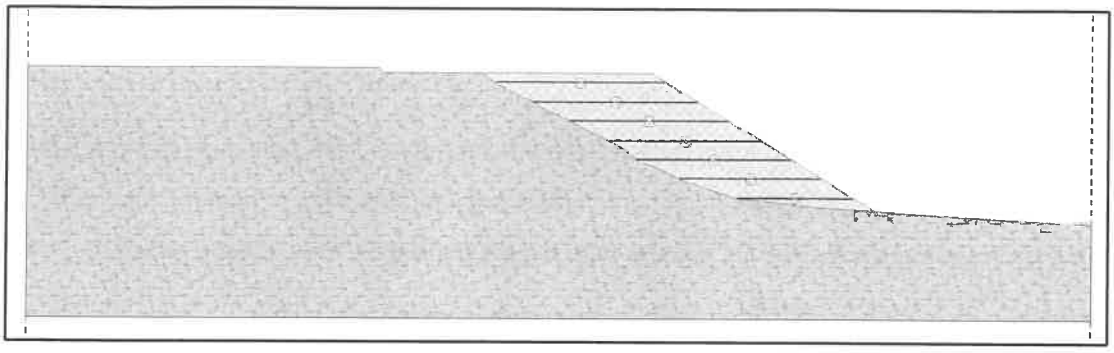


Figure 4: Reinforced Slope Example

Other solutions include soil nailing and gabion walls. However, these may not be appropriate for the site due to land constraints, construction issues, access issues and the bearing material properties.

Final landscape/reprofiling designs should be checked by a suitably qualified and experienced geotechnical engineer.

5 Assessment of Green Wall and Reinforced Slope Option

We have carried out some preliminary slope analysis on the modified indicative sections which incorporate a 1.5m approximate height green retaining wall (Flex MSE or similar). Our analysis includes the use of geogrid at 1m spacing, with tighter spacing behind the green wall.

This demonstrates that in principle the use of geogrids and an MSE type green wall is feasible.

Examples of our analyses are appended.

The analyses in this report make a number of assumptions based on limited ground investigation data.

6 Conclusions and Recommendations

- The site is currently undeveloped. There is evidence of previous ground movement.
- The E3P 2019 Ground investigation determined the subsurface to consist of Glacial Deposits (variable clays and gravels) to up to 4m bgl. This was the maximum depth investigated. Groundwater was not encountered during monitoring, and it is not anticipated at shallow depths below the slope.
- Slope stability analyses resulted in utilisation exceedance for two sections modelled in the existing slope configuration.
- The proposed site configuration without treatment/reinforcement including the cut and fill of the site was analysed using Geo5 software. The results indicate utilisation exceedances for the proposed levels.
- We have now assessed the recent proposals based on a preliminary model and our current understanding of the ground conditions the use of the modified slope, reinforced with geogrids and a sub-vertical green wall. These can be demonstrated to be feasible.
- If this is the preferred option then a detailed design will need to be developed, following some deeper ground investigation, to enable full assessment of the slope profile.
- It is important to note that soil parameters used during these analyses are based on back analysis of the slope, assuming a current factor of safety of 1. Further ground investigation is recommended to achieve more geotechnical understanding of the subsurface.

7 References

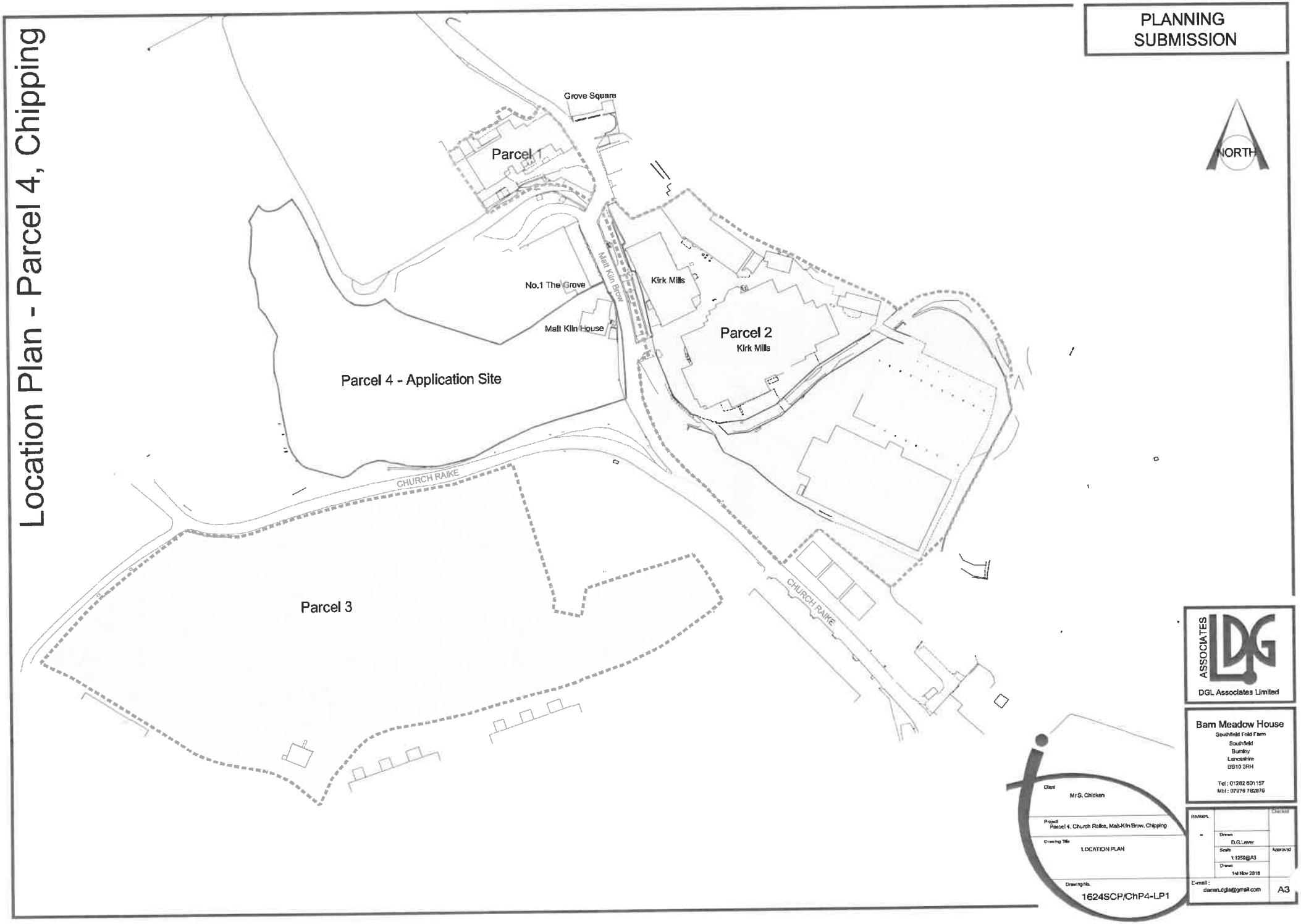
1. Ordnance Survey mapping.
2. BGS Sheet 1:50000 scale Sheet 67 Garstang.
3. Phase II Geo-environmental Site Assessment, by E3P. Dated May 2018. Report No. 12-424.
4. Proposed Site Plan Drawing, by Hodson Homes. Dated May 2022. Drawing No. MKB/SP01.
5. Location Plan Drawing , by DGL Associates. Dated November 2018. Drawing No. 1624SCP/ChP4-LP1.
6. Existing Survey of Site (Part 2 of 3), by 5plus architects. Dated January 2014. Drawing No. 05024_MP_00_111.
7. Boundary Treatment Elevations and Details, by Hodson Homes. Dated June 2022. Drawing No. BTD/P20.
8. Proposed Site Section, by Hodson Home. Dated June 2022. Drawing No. MKB/P02.
9. Proposed Site Plan, by Hodson Homes. Dated May 2022. Drawing No. MKB/SP01.
10. Hard Landscaping, Soft Landscaping and Boundary Treatment Layout, by Hodson Homes. Dated June 2022. Drawing No. LAN/BND/P01.

Appendix A

Drawings

Location Plan - Parcel 4, Chipping

PLANNING SUBMISSION



ASSOCIATES LDG
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Barn Meadow House
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BB10 3RH

Tel : 01282 601157
Mbl : 07976 782876

Client: Mr S. Chicken

Project: Parcel 4, Church Raike, Malt Kiln Brow, Chipping

Drawing Title: LOCATION PLAN

Drawing No.: 1624SCP/ChP4-LP1

Revisions: -

Drawn: D.G.Lever

Scale: 1:1250@A3

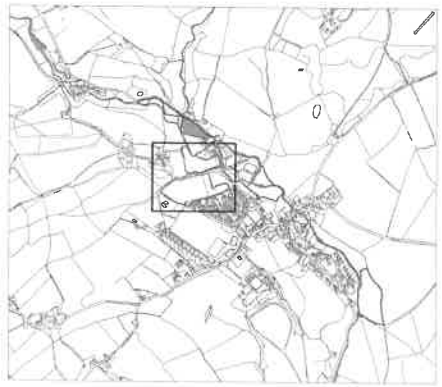
Dated: 1st Nov 2018

Checked:

Approved:

E-mail : darren.dgla@gmail.com

A3



Application Site Boundary

Additional Land in Ownership of Applicant

REV	DATE	DETAILS

5plus architects

4th Floor
The Hive
47 Lever Street
Manchester
M1 1FW

+44 (0)161 228 0211

www.5plusarchitects.com

PROJECT
Chipping
Masterplan

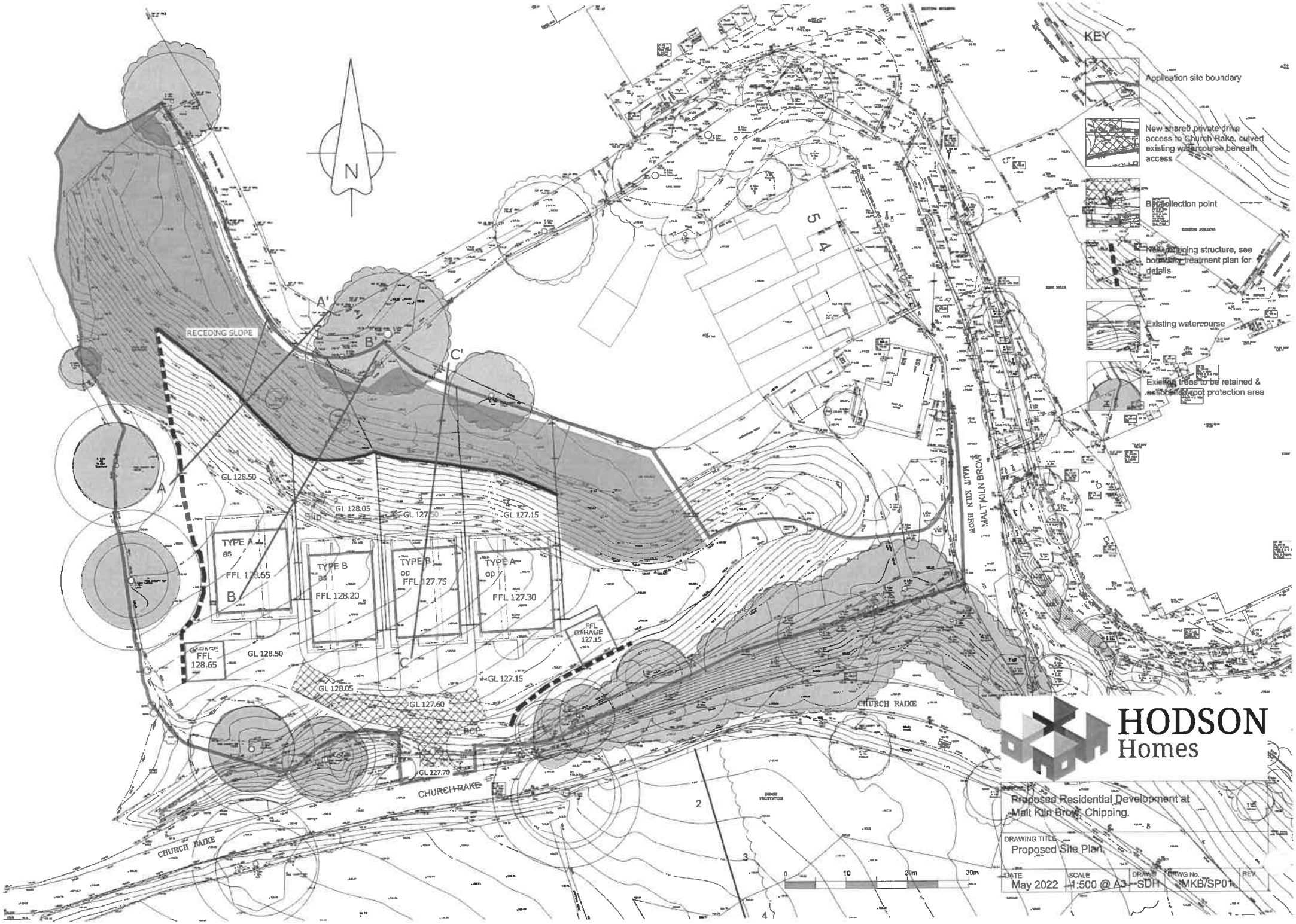
TITLE
Existing Survey of Site (Part 2 of 3)

SCALE	DATE	DRAWN	CHECKED
1:500 A1	24.01.14	JDH	JM

STATUS
Planning

DRAWING NO
6/5024 _MP_00_111

REV
-


KEY
Application site boundary
New shared private drive access to Church Rake, culvert existing watercourse beneath access
Bin collection point
New hedging structure, see boundary treatment plan for details
Existing watercourse
Existing trees to be retained & associated root protection area
N
RECEDING SLOPE
A
A'
B
B'
C
C'
GL 128.50
GL 128.05
GL 127.50
GL 127.15
TYPE A as
FFL 128.65
TYPE B as
FFL 128.20
TYPE B op
FFL 127.75
TYPE A op
FFL 127.30
GARAGE FFL 128.65
FFL GARAGE 127.15
GL 128.50
GL 127.15
GL 128.05
GL 127.60
GL 127.70
CHURCH RAIKE
MALT KILN BROW
54
1
2
3
4
0
10
20m
30m
HODSON
Homes
Proposed Residential Development at
Malt Kiln Brow, Chipping.
DRAWING TITLE
Proposed Site Plan
DATE
May 2022
SCALE
1:500 @ A3
DRAWN
SDH
DRWG No.
MKB/SP01
REV

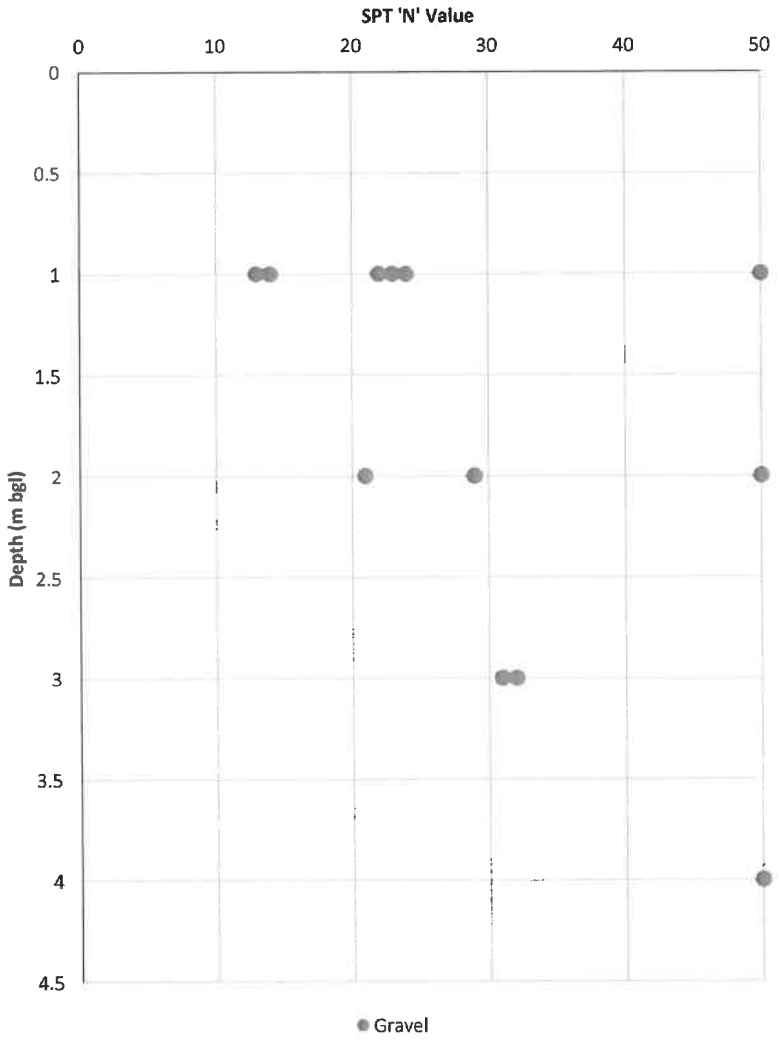
Appendix B

Parameter Plots

Ground and Project CONSULTANTS LTD

Project:	Chipping		
Project No.	80783		
Calc Title:	SPT vs Depth Plot		
Date:	15 June 2022	**Rev**	0

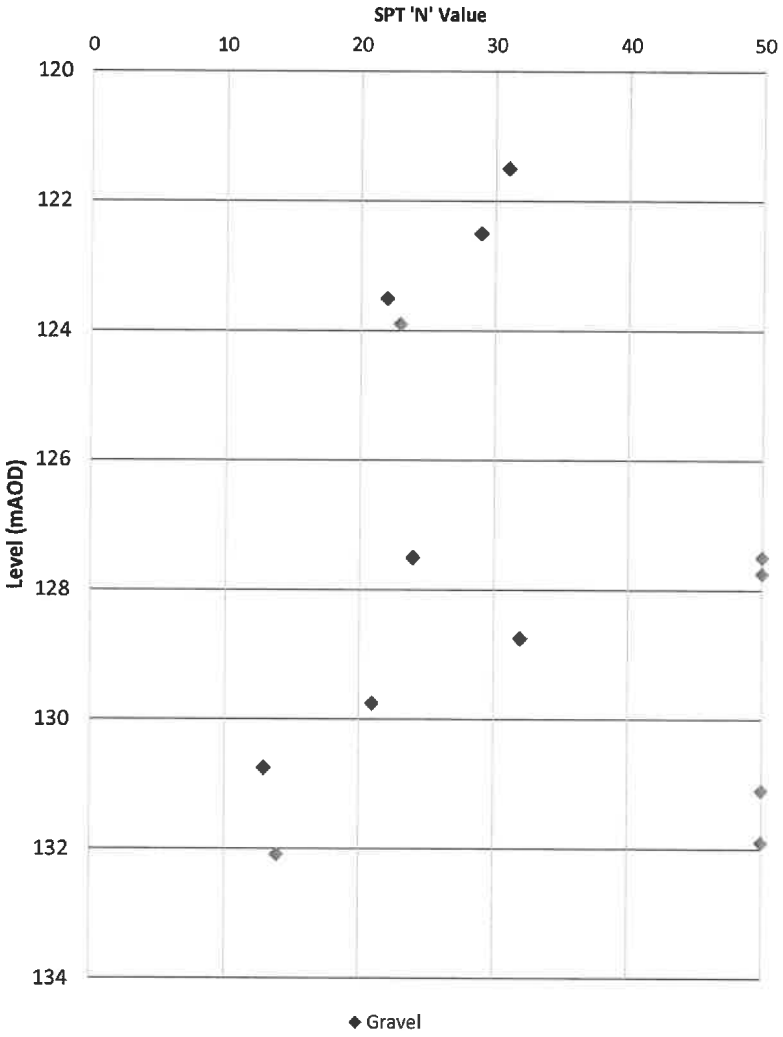
SPT vs Depth Plot



Ground and Project CONSULTANTS LTD

Project:	Chipping		
Project No.	80783		
Calc Title:	SPT vs Level Plot		
Date:	15 June 2022	**Rev**	0

SPT vs Level Plot



Appendix B

Parameter Plots

Appendix C

E3P Phase II Geo-environmental Site Assessment

PHASE II GEO-ENVIRONMENTAL SITE ASSESSMENT

Land North of Church Raike
Chipping
Preston
PR3 2QL

Prepared for:

Chipping Homes Ltd

Report Ref: 12-424
Date Issued: May 2018

e3p | Environmental | Energy | Engineering

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QUALITY ASSURANCE

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CHECKED BY	R. Walker
QUALIFICATIONS	BSc(Hons), FGS, IAEG
SIGNATURE	
AUTHORISED BY	M Dyer
QUALIFICATIONS	BSc, FGS, AIEMA, MIEnvSc, CEnv
SIGNATURE	
PROJECT NUMBER	12-424

EXECUTIVE SUMMARY		
Site Address	(Parcel 4) Land North of Church Raike, Chipping, Preston, PR3 2QL	
Grid Reference	E 361944, N 443515	
Site Area	Circa 0.6Ha	
Current Site Use	The site is an irregular parcel of land to the north of the town of chipping, north east of Preston within the forest of Bowland area of natural beauty. Chipping Brook is located along the northern boundary of the site circa 2.50m lower in elevation than the site. The site is a natural mound generally with the surrounding land to the west, but circa 2m in elevation to the road to the south and east. A steep ramp from the east provides current temporary access to the site that has been formed to facilitate the Ground Investigation works. Upon entering the site, and at the top of the access slope, the developable area is generally topographically level as a plateaux. This area in the site is circa 3m higher than the surrounding land. The site is predominantly covered in grasses with mature and semi mature trees forming the boundary in conjunction with a post and wire fence to the west and stone wall to the south.	
Proposed Development	E3P have not been provided with a proposed development plan as yet however, it is expected that the intention will be to construct a low rise residential development comprising a number of mixed dwellings with associated gardens, estate roads and infrastructure. It is understood that there will be a significant cut and fill exercise across the site to create a level platform for the development.	
Environmental Setting	*Drift Geology*	Till (Devensian – Clay) across the site.
	Bedrock Geology	Park Style Limestone Member – Limestone
	Hydrogeology	Secondary Undifferentiated (drift) overlying Secondary A aquifer (Solid). No groundwater abstractions have been identified within a 1km radius.
	Hydrology	Chipping Brook is located circa 4m north.
	Flood Risk	Unaffected by flooding from rivers.
	Subsidence Hazard	Moderate Risk
Site History	A review of the pertinent Ordnance Survey mapping dating from circa 1850 to the present day confirmed the site has been greenfield to present day.	
Previous Reports	To E3Ps knowledge there have not been any reports completed previously pertinent to the specific parcel within the wider chipping development area. Brownfield solutions have previously completed a desk study report that included this parcel within a larger area however, no intrusive works have been completed.	
Utility Locations	A review of online utility plan for the site and surrounding area inform a combined sewer running along the northern boundary to the site and a further surface water line along Church Raike to the south of the site.	

EXECUTIVE SUMMARY	
Landfill Sites & Ground Gases	There are no current registered landfill sites within 2000m of the site. There are two historic landfill sites within 1000m of the site. Both these sites are located 642m from the site and are licenced to Colte Coates farm. The licence was surrendered on 29th April 1994 with the waste type noted as inert.
Radon	The site is in an area where full radon precautions may be required in accordance BRE Report 211 'Radon – Guidance on protective measures for new dwellings' 2007 Edition.
Coal Mining / Land Stability	The site is not within an area of historic or future coal mining. As such there is no requirement for further assessment.
E3P Intrusive Ground Investigation	
Site Investigation Works	E3P has completed an intrusive Ground Investigation comprising mechanically excavated trial pits, window sample boreholes, super heavy dynamic probe tests and environmental monitoring installations.
Ground Conditions	**Made Ground** Made Ground has not been encountered within any exploratory hole locations during the investigation. Due to the lack of historic development across the site the absence of anthropogenic fill material is to be expected. **Drift** Drift deposits were encountered within all exploratory locations to depths of between 0.20m and in excess of 4.0m bgl. The drift deposits are generally consistent and comprise a dark brown sandy silty clayey gravel of sandstone, mudstone and limestone. Generally, with depth the size and content of the granular components increases with boulders becoming more frequent. There is also localised yellowish brown sandy gravelly clay to depths between 0.2 and in excess of 1.0m in window samples and trial pits in the west and south of the site. This is also locally interbedded with the dark brown clayey gravel and gravelly glay. **Solid** The solid bedrock geology has not been encountered due to obstructions in the form of oversize boulders at depths in excess of 6m bgl impeding the penetration of drilling and testing equipment. The use of a Super Heavy Dynamic Probe test advanced the investigation to a depth of 13.0m bgl however, again refusal in dense gravels and obstructions ceased progress. The solid geology is indicated to comprise limestone bedrock from BSG information, however, historical borehole memoirs in the area show Millstone Grit (Carboniferous Sandstone) from 15.00m bgl. **Groundwater** Groundwater has been encountered as slow seepages and perched water at depths between 0.90m and 2.00m bgl.

EXECUTIVE SUMMARY	
Human Health	A Tier I Human Health Risk Assessment has been undertaken using the chemical analysis results of the soils and comparing to the relevant Tier I criteria. This assessment has identified the presence of a single isolated occurrence of dibenzo(a,h)anthracene. The identified elevated concentration has primary exposure pathway related to dermal contact and ingestion, soil ingestion and consumption of homegrown produce. This is considered to be an isolated occurrence and so during a phase of enabling works to construct a suitable development platform this will be treated as a hotspot, delineated with the impacted soils removed and placed in an area of low future impact. Chemical analysis of the natural drift deposits and topsoils have identified these soils to be acceptable for use within the future development, however further chemical validation samples will be required to confirm this.
Controlled Waters	A controlled waters risk assessment has been completed using the leachate samples taken during the site investigation. A marginal exceedance of Cadmium has been identified however, given the general low soluble nature of the identified contaminant of concern in addition to the relatively low sensitivity of the site with respect to controlled waters, it is considered there is unlikely to be any degree of unacceptable risk to the controlled water receptors and the wider environ.
Ground Gas	A CL;aire RB17 assessment has been completed due to the lack of potential sources of ground gas production. This assessment achieved a point score of 15 which classifies the site as suitable for CS1/green characterisation. As such gas mitigation measures will not be required in the construction of new dwellings.
Potable Water Infrastructure	The site is suitable for PE Potable Supply Infrastructure.
Geotechnical Assessment	
Underground Obstructions & Anomalies	Relic obstructions are not expected and were not exposed during the intrusive Ground Investigation however; the presence of oversized materials within the natural strata cannot be ruled out. During a phase of cut fill enabling works to create a developable platform, all below ground obstructions will require grubbing out to enable the construction of proposed sub-structure and infrastructure. The current ditch will present areas of locally poor ground, these areas will need to be located, delineated and investigated prior to the excavation and removal of all deleterious materials. The resulting excavation should be backfilled with material to be engineered in accordance with a suitable geotechnical specification in due consideration of the end use.
Allowable Bearing Pressure	The underlying natural granular drift deposits have been assessed as being medium dense to dense with a net ABP in the order of 150kN/m^2 at circa 1.00m bgl increasing to in excess of 150-200kN/m^2 with depth.

EXECUTIVE SUMMARY	
Foundation Options	Due to the existing large variances in the site topography, a phase of cut and fill enabling works will be required to create a development platform suitable for a residential development. This will generally comprise increasing levels on the north and south side of the development strip to increase the slope stability. Given the nature of the site and proposed detached bespoke dwellings it will be necessary for the project Structural Engineer to design specific foundations for each dwelling considering the proposed floor levels, sub-structure design and post enabling works ground conditions. It is considered probable the foundation solutions will be a combination of shallow strip, deeper Trench Fill and specialist engineered solutions to include Pier & Beam's and possible transfer of loads by piling.
Building Floor Slabs	Ground bearing floor slabs are unlikely to be viable given the anticipated depths of shallow highly clay bound granular soils.
Heave Precautions	The underlying material is considered to be predominantly granular in nature and therefore precautions to limit the effect of volumetric instability associated with cohesive soils will not be necessary in the design of the proposed development.
Soakaway Drainage	The Made Ground and underlying granular soils have a high cohesive content which would preclude the use of infiltration drainage systems.
Sulphate Assessment	Concrete classification will be DS1 AC1s.
CBR Design %	Granular soils can be re-engineered to ensure 5% within the sub-grade during favourable climatic conditions. Natural clay soils will provide a CBR in the order of 3-4% during drier climatic periods, however If water is allowed to shed onto the formation, the CBR will reduce to <2% which will require specialist engineering of the sub-grade.
Cut / Fill	Development levels unknown at this time, however significant cut fill works will be required to prepare the development platform.
Waste Characterisation	Stable Non-Reactive (non-hazardous / inert). Any material that is to be disposed to landfill should undergo assessment using Technical Guidance WM3: *Waste Classification - Guidance on the classification and assessment of waste.*
Slope Stability	Steep sloped embankments are present to the north and south of the proposed development area. As and when the proposed detailed development design is finalised, it will be necessary to undertake modelled slope assessment to assess the Ultimate Limit State stability of the final slope contour to consider any applied structural or infrastructure loading.
Recommendations	Based on the findings of the intrusive site investigation, the following additional works are recommended to be completed in due course: • Slope Stability Assessment; • Plot Specific Foundation Schedule (upon receipt of the final development levels); • Arboriculture Survey; • Geotechnical Earthworks Strategy (Infrastructure). • Remediation & Enabling Works strategy;

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1. INTRODUCTION

1.1 Background

E3P understands that Chipping Homes Ltd. are currently appraising the proposed future development of Parcel 4 for low rise residential housing with associated adopted estate roads and utility infrastructure.

This report is required to determine potential contaminated land liabilities, remediation requirements and geotechnical engineering works that will be required as part of the proposed development for the proposed low rise residential development.

The scope of work consisted of following elements.

- *Detailed review of historic information;*
- *Review of Desk Study information;*
- *Design of suitable intrusive Ground Investigation;*
- *Window sample probeholes with and construction of environmental monitoring installations;*
- *Mechanically excavated trial pits;*
- *In-situ Geotechnical Testing;*
- *Chemical & Geotechnical Laboratory analysis;*
- *Groundwater monitoring and sampling;*
- *Ground gas monitoring;*
- *Contamination Risk Assessment & Conceptual Site Model;*
- *Geotechnical Assessment & Interpretation; and,*
- *Factual and interpretive reporting.*

1.2 Proposed Development

The proposed dwellings in this sector will be constructed at the higher elevation of the site with access to be gained from the highway to the east at a lower elevation.

To inform the development of this proposal, E3P visited site to review the access requirements and viable exploratory excavation techniques given the landform tapers with two areas of steep erosion to the north and south of the proposed development platform.

As part any future investigation, slope stability assessment is required to assess the potential mechanism for future failure and re-grade and re-enforcement requirements to ensure the require factor of safety in the construction of the dwellings.

A snapshot of the wider chipping development area is indicated in Figure 1.1 overleaf:

Figure 1.1 Snapshot of Proposed Development

1.3 Objectives

The objectives of the Geo-Environmental Investigation are to:

- Undertake a preliminary stage of sampling and analysis to provide an overview of environmental issues identified;
- Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors;
- Assess the geotechnical information and provide preliminary recommendations in relation to foundations, pavement construction and floor slabs; and,
- Provide recommendations regarding future works required.

1.4 Previous Reports

The following reports have previously been completed for the site:

Brown Field Solutions - *Desk study assessment report, Church Raike, Chipping.* Ref: Report No. LC/C2179/3452, dated 14 January 2016.

Brown Field Solutions - Geo-environmental assessment, Church Raike, Chipping. Ref: Report No. AJH/C2179/3577, dated 7 March 2013.

The Brownfield solutions report, whilst inclusive of the site, mainly focus on the phase 3 area of the proposed chipping redevelopment. No intrusive instigation has been completed within

the phase 4 area within their report. As such, there are no points specific and pertinent to the subject site.

1.5 Limitations

The limitations of this report are presented in Appendix I.

1.6 Confidentiality

E3P has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from E3P; a charge may be levied against such approval.

2. E3P GROUND INVESTIGATION

2.1 General Overview

A Ground Investigation has been designed based on the findings of the desk study with exploratory holes advanced to target specific potential contaminant sources summarised in Table 6.1. The investigation has also been used to collect geotechnical information to assist in the design and construction of the proposed development.

Exploratory fieldwork was completed between the 18th April 2018 and the 19th April 2018. The works are summarised in Table 2.1 below.

Table 2.1 Summary of Fieldwork

POTENTIAL SOURCE/RATIONALE	LOCATION HOLE	TYPE	MAXIMUM DEPTH (mbgl)	MONITORING WELLS RESPONSE ZONE (mbgl)
General Ground Conditions including the presence / nature of obstructions.	WS101A	Window Sample Probehole	2.45	N/A
	WS101B		2.45	0.5-2.0
	WS101C			N/A
	WS102		4.45	0.5-4.0
	WS103A		1.45	N/A
	WS103B		2.45	N/A
	WS103C		1.45	N/A
	WS104A		1.45	N/A
	WS104B		3.45	0.5-3.0
General Ground Conditions including the presence / nature of obstructions.	TP101-TP108	Mechanically Excavated Trial Pit	3.50	N/A
Deeper Geotechnical testing	SHDP1	Super Heavy Dynamic Probe Test	7.00	N/A
	SHDP2		13.00	N/A

Mechanically excavated trial pits were advanced to investigate ground conditions and to retrieve environmental samples, spatially distributed to offer the maximum site coverage whilst also being advanced to target specific contaminant sources.

Window sample probeholes were advanced to undertaken in-situ detailed geotechnical testing, obtain environmental samples and install groundwater and ground gas monitoring wells.

The series of super-heavy dynamic probing were advanced to investigate the potential presence of shallow bedrock and to investigate the strengths of soils at depths greater than 5m bgl.

The sampling locations are illustrated in Drawing 10-470-005 (Appendix III). The ground conditions encountered are indicated on the logs which are provided in Appendix VI.

Return visits were made to monitor installations for groundwater level however, all locations were found to be dry.

2.2 In-Situ Standard Penetration Testing (SPT)

In-situ geotechnical testing was conducted using the Standard Penetration Test (SPT) and where the ground is granular, a 60° cone (SPT(C)) was used instead of the sampling tube. The results are shown in the probehole logs in Appendix VI and presented in Table 3.4 and discussed in Section 5.0.

2.3 Laboratory Analysis

Selected soil samples were submitted for a range of chemical analysis comprising, metals, pH, total sulphate, water soluble sulphate (2:1 extract), sulphide, cyanide, phenols, total and speciated poly-aromatic hydrocarbons (PAHs), SVOCs, VOCs, asbestos and total and speciated petroleum hydrocarbon (TPH).

I2 Analytical undertook the analytical work and the testing results are included in Appendix VII and discussed in Section 4.0

Selected samples were submitted to PSL Laboratory where the following geotechnical tests were undertaken:

- Course grained PSD (with 600 series classification)
- Dry density and optimum moisture content

Laboratory analysis sheets are included in Appendix IX and are summarised in Section 5.0:

3. GROUND AND GROUNDWATER CONDITIONS

3.1 Ground and Groundwater Conditions

3.1.1 Summary of Ground Conditions

The Ground Investigation generally confirms the published geology and identifies the strata set out in Table 3.1 below:

Table 3.1 Summary of Strata

HOLE	DEPTH TO STRATUM (MBGL)					
	TOPSOIL	CLAY	ORG SILT	SAND	GRAVEL	BED ROCK
WS101A	0.00-0.40	0.40-0.80	-	-	0.80-2.00	-
WS101B	0.00-0.20	-	-	-	0.20-2.00	-
WS101C	0.00-0.20	-	-	-	0.20-2.00	-
WS102	0.00-0.30	-	-	-	0.30-4.00	-
WS103A	0.00-0.30	-	-	-	0.30-2.00	-
WS103B	0.00-0.30	-	-	-	0.30-2.00	-
WS103C	0.00-0.40	-	-	-	0.40-1.00	-
WS104A	0.00-0.20	-	-	-	0.20-2.00	-
WS104B	0.00-0.50	-	-	-	0.50-3.00	-
TP101	0.00-0.50	-	-	-	0.50-3.20	-
TP102	0.00-0.20	-	-	-	0.20-3.40	-
TP103	0.00-0.20	0.20-1.00	-	-	1.00-2.90	-
TP104	0.00-0.30	1.60-3.00	-	-	0.30-1.60	-
TP105	0.00-0.40	-	-	-	0.40-2.80	-
TP106	0.00-0.80	-	-	-	0.80-3.10	-
TP107	0.00-0.60	0.60-1.20	-	-	1.20-3.50	-
TP108	0.00-0.30	0.30-1.80	-	-	1.80-3.50	-

3.1.2 Made Ground

Made Ground has not been encountered within any exploratory hole locations during the investigation. Due to the lack of historic development across the site this is to be expected.

3.1.3 Drift Deposits

Drift deposits were encountered within all exploratory locations to depths of between 0.20m and in excess of 4.0m bgl.

The drift deposits are generally consistent and comprise a dark brown sandy silty clayey GRAVEL of sandstone, mudstone and limestone. Generally, with depth the size and content of the granular components increases with boulders becoming more frequent.

There is also localised yellowish brown sandy gravelly CLAY to depths between 0.2 and in excess of 1.0m in window samples and trial pits in the west and south of the site. This is also locally interbedded with the dark brown clayey GRAVEL and Gravelly CLAY.

3.1.4 Solid Geology

The solid bedrock geology has not been encountered due to obstructions in the form of oversize boulders at depths in excess of 6m bgl stopping the penetration of drilling and testing equipment. The use of a Super Heavy Dynamic Probe test advanced the investigation to a depth of 13.0m bgl however, again refusal in dense gravels and obstructions ceased progress. The solid geology is indicated to comprise limestone bedrock from BSG information, however, boreholes scans in the area show Millstone Grit (Carboniferous Sandstone) from 15.00m bgl.

3.1.5 Groundwater

Groundwater strikes were encountered as seepages. The depth of the seepages are shown on the exploratory hole records and summarised in Table 3.2 below:

Table 3.2 Summary Groundwater Strikes

LOCATION	DEPTH TO STRIKE (m)	NOTES
TP107	1.30	Very slow seepage
TP108	0.90	Slow perched
TP108	1.40	Slow seepage
TP108	2.00	Slow seepage

3.1.6 Visual and Olfactory Evidence of Contamination

Visual and olfactory evidence of potential contamination has not been identified during the site investigation.

3.1.7 Soil Consistency

Due to the heavily granular nature of the soils encountered on site Undrained shear strength could not be completed. However, results of the Standard Penetration Tests, including soils densities derived from SPTs are included on Table 3.3.

3.1.8 Side Stability and Ease of Excavation

The sides of the exploratory trial pit excavations appeared to be generally stable during excavation.

The presence of mudstone cobbles in clayey gravel deposits meant that in certain places excavation was slow through the natural ground. The topsoil strata was excavated with relative ease.

Table 3.3 Standard/Cone Penetration Test Results

BOREHOLES	DEPTH (mbgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE $(N_1)_{60}$	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m²)
WS101a	1	sandy silty clayey gravel	14	14.11	Medium Dense	N/A	N/A	N/A
	2	sandy silty clayey gravel	50	45.68	Dense	N/A	N/A	N/A
WS101b	1	sandy silty clayey gravel	50	50.41	Very Dense	N/A	N/A	N/A
WS102	1	sandy silty clayey gravel	13	13.11	Medium Dense	N/A	N/A	N/A
	2	sandy silty clayey gravel	21	19.18	Medium Dense	N/A	N/A	N/A
	3	silty clayey gravel	32	27.83	Medium Dense	N/A	N/A	N/A
	4	sandy silty clayey gravel	50	42.24	Dense	N/A	N/A	N/A
WS103a	1	sandy silty clayey gravel	24	24.20	Medium Dense	N/A	N/A	N/A
	2	sandy silty clayey gravel	50	45.68	Dense	N/A	N/A	N/A
WS103b	1	sandy silty clayey gravel	50	50.41	Very Dense	N/A	N/A	N/A
WS104a	1	sandy silty clayey gravel	23	23.19	Medium Dense	N/A	N/A	N/A
	2	sandy silty clayey gravel	50	45.68	Dense	N/A	N/A	N/A
WS104b	1	sandy silty clayey gravel	22	22.18	Medium Dense	N/A	N/A	N/A
	2	sandy silty clayey gravel	29	26.49	Medium Dense	N/A	N/A	N/A
	3	sandy silty clayey gravel	31	26.96	Medium Dense	N/A	N/A	N/A

3.1.9 Soil Infiltration

Permeability testing has not been completed on this occasion however, considering the presence of low permeability clay within the gravel on the site, it is considered that soakaway drainage may not be suitable for the proposed development. However, the application of soakaway drainage will ultimately be dependent on the specific requirements of the development. All soakaways should be designed in accordance with BRE Special Digest 365 – *Soakaway Design*.

3.1.10 pH and Sulphate

Chemical analyses for pH and soluble sulphate content contained in Appendix VII (summarised below in Table 3.4), shows that the soils at the site generally meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE Special Digest 1 (2005).

Table 3.4 Summary of pH and Sulphate Data

LOCATION	DEPTH (m)	SO_4 IN 2:1 WATER / SOIL (g/l)	pH VALUE	CLASSIFICATION
TP101	0.30	0.019	7.9	DS-1, AC-1s
TP101	2.00	0.12	8.0	DS-1, AC-1s
TP103	0.40	0.0061	7.4	DS-1, AC-1s
TP104	0.20	0.013	6.9	DS-1, AC-1s
TP104	2.50	0.29	8.0	DS-1, AC-1s
TP107	0.20	0.0092	7.6	DS-1, AC-1s
WS101A	0.40	0.015	7.1	DS-1, AC-1s
WS101B	1.20	0.025	8.2	DS-1, AC-1s
WS103A	0.80	0.020	7.1	DS-1, AC-1s
WS103B	1.80	0.34	6.9	DS-1, AC-1s

3.2 Ground Gas

A ground gas assessment has been completed in accordance with guidance provided within CIRIA 665 *Assessing risk posed by hazardous ground gases to buildings*.

3.2.1 Investigation Rationale

The ICSM has identified that the site represents a very low ground gas source generation potential.

Within the context of the proposed residential end use and ground gas generation potential, it has been deemed appropriate in this instance to utilise an RB17 assessment with reference to standards and guidelines published in CIEH Research Bulletin 17 *A Pragmatic Approach to Ground Gas Risk Assessment* (RB17).

4. TIER I QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

E3P has undertaken a Tier 1 qualitative risk assessment to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

4.1 Human Health Risk Assessment

At a Tier 1 stage the long term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with reference values published in LQM / CIEH S4UL (S4UL3267).

The results of this comparison have been summarised within Table 4.1 (overleaf).

Table 4.1 Summary of Inorganic and Hydrocarbon Toxicity Assessment for a Residential End Use

DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH-WAY	ASSESSMENT
Arsenic	mg/kg	37	10	23	N/A	1	No Further Action
Cadmium	mg/kg	11	10	3.3	N/A	1	No Further Action
Chromium (VI)	mg/kg	6.1	10	2.9	N/A	1	No Further Action
Lead	mg/kg	200	10	60	N/A	1	No Further Action
Mercury	mg/kg	11	10	< 0.3	N/A	2	No Further Action
Nickel	mg/kg	180	10	52	N/A	1	No Further Action
Selenium	mg/kg	250	10	13	N/A	1	No Further Action
Copper	mg/kg	2400	10	47	N/A	1	No Further Action
Zinc	mg/kg	3700	10	160	N/A	1	No Further Action
Cyanide - Total	mg/kg	791	10	< 1.0	N/A	1	No Further Action
Phenols - Total.	mg/kg	210	10	< 1.0	N/A	1	No Further Action
Asbestos	Fibres	NFD	6	Not detected	N/A		No Further Action
Naphthalene	mg/kg	2.3	10	< 0.05	N/A	2	No Further Action
Acenaphthylene	mg/kg	170	10	< 0.05	N/A	3	No Further Action
Acenaphthene	mg/kg	210	10	< 0.05	N/A	1	No Further Action
Fluorene	mg/kg	170	10	< 0.05	N/A	1	No Further Action
Phenanthrene	mg/kg	95	10	0.32	N/A	3	No Further Action
Anthracene	mg/kg	2400	10	< 0.05	N/A	3	No Further Action
Fluoranthene	mg/kg	280	10	0.97	N/A	3	No Further Action
Pyrene	mg/kg	620	10	0.85	N/A	3	No Further Action
Benzo(a)Anthracene	mg/kg	7.2	10	0.62	N/A	3	No Further Action
Chrysene	mg/kg	15	10	0.42	N/A	3	No Further Action
Benzo(b)Fluoranthene	mg/kg	2.6	10	0.62	N/A	3	No Further Action
Benzo(k)Fluoranthene	mg/kg	77	10	0.24	N/A		No Further Action
Benzo(a)Pyrene**	mg/kg	2.2	10	0.45	N/A	3	No Further Action
Indeno(123-cd)Pyrene	mg/kg	27	10	0.22	N/A	3	No Further Action
Dibenzo(a,h)Anthracene	mg/kg	0.24	10	0.62	TP104 0.20m	3	Further Action
Benzo(ghi)Perylene	mg/kg	320	10	0.22	N/A	3	No Further Action
TPH C5-C6 (aliphatic)*	mg/kg	42	10	< 1.0	N/A	2	No Further Action
TPH C6-C8 (aliphatic)*	mg/kg	100	10	< 0.1	N/A	2	No Further Action
TPH C8-C10 (aliphatic)*	mg/kg	27	10	< 0.1	N/A	2	No Further Action
TPH C10-C12 (aromatic)*	mg/kg	74	10	14	N/A	2	No Further Action
TPH C12-C16 (aromatic)*	mg/kg	140	10	30	N/A	2	No Further Action
TPH C16-C21 (aromatic)*	mg/kg	260	10	34	N/A	1	No Further Action
TPH C21-C35 (aromatic)*	mg/kg	1100	10	48	N/A	1	No Further Action

Notes
Main Exposure Pathways: 1 = Soil Ingestion, 2 = Vapour Inhalation (indoor), 3 = Dermal Contact & Ingestion, 4 = Dust Inhalation.
Abbreviations: GAC = General Assessment Criteria, n = number of samples, MC = Maximum Concentration; Loc of Ex = Location of Exceedance; NFD = No Fibres Detected
* The Tier 1 GAC for the hydrocarbon fraction is derived from the CIEH assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. E3P has utilised the Tier 1 values for aliphatic compounds for the volatile and semi volatile fractions (C_5-C_{12}) and the Tier 1 values for aromatic compound for the non-volatile fractions (C_{12}-C_{35}). The comparison of a total (aliphatic/aromatic) compounds to an individual fraction is considered to be a conservative approach and satisfactory for the protection of human health.

Referring to Table 10.1, the results of this direct comparison indicates that the data exceeds the screening criteria for a residential end use for the following contaminants:

- Dibenzo(a,h)Anthracene

No significant concentrations of Chlorinated solvents were identified in the soils submitted for chemical analysis. Chlorinated solvents pose a particular risk due to their potential for dissolution into groundwater. In this case the identified contaminant has low mobility and therefore can be considered to be an isolated hotspot.

The laboratory analysis confirms the assessment within the initial conceptual site model that the main constituents of concern were likely to be PAHs.

In relation to these exceedances, the following can be determined:

- The main exposure pathways based on the Tier I exceedances are:

    1. Soil Ingestion
    2. Vapour Inhalation (Indoor)
    3. Dermal Contact and Ingestion
    4. Consumption of Homegrown Vegetables
    5. Fibre / Dust Inhalation

- The exceedances for all determinands are associated with shallow Made Ground deposits (<0.40m).

Risk Assessment and Mitigation

The identified elevated concentration has a primary exposure pathway related to dermal contact and ingestion of soils and consumption of home-grown vegetables. The chronic risk to human health associated with the elevated concentrations of non-volatile PAH compounds can be mitigated through the installation of a suitable cover system in all proposed private gardens, landscaping and Public Open Space to remove any potential for direct exposure to impacted soils.

With regards to the elevated Dibenzo(a,h)Anthracene, this presents a potential risk if a person ingests or comes into dermal contact with the substances. These elevated concentrations have only been identified within one area of the site and are therefore considered to be a localised contamination. However, the 600mm will be sufficient cover to remediate the elevated concentrations. Soils will be chemically validated to assess chemical suitability for retention on site in an area of no future sensitivity.

However, in this instance there are no Made Ground soils and the contaminant is found to be an isolated occurrence. Provided this is treated as a hotspot during preparatory works and the materials are delineated, removed and validated to confirm suitability for re-use, a cover system will not be required and the remaining topsoil across the site can be re-used within the future development as growing medium. The removal of the source to an area of low future sensitivity is considered sufficient to break the source-pathway-receptor model to ensure a low risk to future end users.

Chemical analysis of the natural clay drift deposits have identified these soils to be acceptable for use as subsoil within the proposed garden areas, however further chemical validation samples will be required to confirm this.

4.2 Controlled Waters Risk Assessment

The site sensitivity with respect to controlled waters is summarised within Table 4.2

Table 4.2 Controlled Waters Sensitivity Profile

RISK PROFILE	DISCUSSION	SENSITIVITY RATING
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	The site is not within a Groundwater Source Protection Zone or Drinking Water Safeguard Zone	Low
Distance to the closest groundwater abstraction point.	None within 2000m	Low
Aquifer Classification in Superficial Drift Deposits.	The superficial drift deposit is classified as a unproductive aquifer. These are layers of drift deposits with low permeability that have negligible significance for water supply or river base flow	Low
Aquifer classification in Bedrock.	The bedrock is classified as a Secondary A aquifer - Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.	Low
Viability for Anthropogenic soil in direct contact with aquifer (drift or bedrock).	The made ground (topsoil) on the surface of the site overlies the unproductive aquifer in the drift.	Low
Is the site located within 50m of a surface watercourse?	Yes – Chipping Brook runs to the north of the site.	Moderate
Summary The ICSM developed within the context of the site setting has only identified a single viable pollutant risk which would be the horizontal migration of potentially mobile phase soluble contaminants towards the adjacent Chipping Brook. However, the overall sensitivity of this receptor is reduced given the absence of any significant pollutant source and thus the potential for the creation of a complete pollutant linkage.		

To further refine the ICSM, E3P has undertaken an initial qualitative assessment of the soil data analysis to assess the potential for a source of separate phase or dissolved phase contamination originating from either a defined on-site source or from impacted soils. This assessment is summarised in Table 4.3.

Table 4.3 Qualitative Risk to Controlled Waters from Soil Analytical Results

BTEX - >1mg/kg **Total VOC - > 1mg/kg**	All concentrations are below the laboratory LOD.
Total SVOC - > 1 mg/kg	Maximum SVOC concentration was detected at 0.97mg/kg.
C5-C10 - > 5mg/kg	All concentrations are below the laboratory LOD.

C10-C12 - > 10mg/kg	All concentrations are below the laboratory LOD.
C12-C16 - > 50mg/kg	All concentrations are below the laboratory LOD.
Phenols – > 2mg/kg	All concentrations are below the laboratory LOD.
Naphthalene - > 2mg/kg	All concentrations are below the laboratory LOD.
Total PAH - > 10mg/kg	All concentrations are below the laboratory LOD.
PCB - > 1mg/kg	All concentrations are below the laboratory LOD.
Heavy metals - > 500mg/kg	Maximum heavy metal concentration across the site is 160mg/kg.

In due consideration of the ICSM which has identified a potential pollutant linkage associated with the migration towards the adjacent Chipping Brook, E3P has undertaken a Tier I controlled waters risk assessment. The Tier I assessment has included a comparison of leachate analysis and groundwater samples to Environmental Quality Standards (EQS) in the first instance and where absent Drinking Water Standards.

These are presented in Table 4.4 overleaf.

Table 4.4 Comparison of Groundwater Analysis with Tier 1 Screening Levels

DETERMINAND	UNITS	EQS SCREENING VALUE [1, 2, 3]		DWS [3,4,5]	N (L-Leachate, GW –Groundwater)	MC	LOC OF EX	ASSESSMENT
		AA	MAC					
Arsenic	µg/l	50	-	10	2 Leachate	1.7	N/A	No Further Action
Cadmium	µg/l	0.08	0.45	5	2 Leachate	0.56	TP102-2.80	**Further Action**
Chromium (VI)	µg/l	3.4	-	-	2 Leachate	<5.0	N/A	No Further Action
Chromium (III)	µg/l	4.7	-	50	2 Leachate	<0.4	N/A	No Further Action
Copper (hardness)	µg/l	1-28		2000	2 Leachate	16	N/A	No Further Action
Total Cyanide	µg/l	1	-	50	2 Leachate	<1.0	N/A	No Further Action
Lead	µg/l	1.2	14	10	2 Leachate	2.2	N/A	No Further Action
Mercury	µg/l	-	0.07	1.0	2 Leachate	<0.5	N/A	No Further Action
Nickel	µg/l	4	34	20	2 Leachate	4.7	N/A	No Further Action
Selenium	µg/l		-	10	2 Leachate	150	N/A	No Further Action
Zinc(hardness)	µg/l	8-125	-	-	2 Leachate	11	N/A	No Further Action
pH		6-9			2 Leachate	7.1-7.4	N/A	No Further Action
PAH								
Naphthalene	µg/l	2	130		2 Leachate	<0.01	N/A	No Further Action
Anthracene	µg/l	0.1	0.1		2 Leachate	<0.01	N/A	No Further Action
Benzo[b]fluoranthene	µg/l	1.7^{-4}	0.017		2 Leachate	<0.01	N/A	No Further Action
Benzo[k]fluoranthene	µg/l	1.7^{-4}	0.017	10*	2 Leachate	<0.01	N/A	No Further Action
Benzo(a)pyrene	µg/l	1.7^{-4}	0.27		2 Leachate	<0.01	N/A	No Further Action
Fluoranthene	µg/l	0.0063	0.12		2 Leachate	<0.01	N/A	No Further Action
Benzo(ghi)perylene	µg/l	1.7^{-4}	8.2^{-3}		2 Leachate	<0.01	N/A	No Further Action
TPH-Aromatic								
TPH C5-C6 (benzene)	µg/l	10	50	1	2 Leachate	<1.0	N/A	No Further Action
TPH C6-C8 (toluene)	µg/l	50	-	700	2 Leachate	<1.0	N/A	No Further Action
TPH C8-C10 (ethyl Benzene)	µg/l	20	-	300	2 Leachate	<1.0	N/A	No Further Action
TPH C10-C12 (xylene)	µg/l	30	-	500	2 Leachate	<10	N/A	No Further Action
TPH C12-C16	µg/l	2	130	90[5]	2 Leachate	<10	N/A	No Further Action
TPH C16-C35	µg/l	50#	50#	90[5]	2 Leachate	<10	N/A	No Further Action
TPH Aliphatic [5]								
TPH C5-C6	µg/l	-	-	15000	2 Leachate	<1.0	N/A	No Further Action
TPH C6-C8	µg/l	-	-	15000	2 Leachate	<1.0	N/A	No Further Action
TPH C8-C10	µg/l	-	-	300	2 Leachate	<1.0	N/A	No Further Action
TPH C10-C12	µg/l	-	-	300	2 Leachate	<1.0	N/A	No Further Action
TPH C12-C16	µg/l	-	-	300	2 Leachate	<1.0	N/A	No Further Action
TPH C16 – C21	µg/l	-	-	300**	2 Leachate	<1.0	N/A	No Further Action
TPH C21-C35	µg/l	-	-	300**	2 Leachate	<1.0	N/A	No Further Action

Notes
Solubility <0.01µg/l
AA – Annual Average
MAC- Maximum Admissible Concentration
* Sum of The specified compounds are benzo[b]fluoranthene (CAS 205-99-2), benzo[k]fluoranthene (CAS 207-08-9), benzo[g,h,i]perylene (CAS 191-24-2) and indeno[1,2,3-c,d]pyrene (CAS 193-39-5)

1. The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations (2015)
2. Directive establishing a framework for Community action in the field of water policy (Water Framework Directive)
3. Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances
4. Council Directive on the quality of water intended for human consumption (Drinking Water Directive)
5. WHO Guidelines for Drinking Water Quality. Third edition (2004)

For the purposes of the Tier 1 assessment E3P has compared the laboratory test data directly to the EQS values, which are for the protection of surface water quality. This assessment is considered to be conservative due to the fact there are not likely to be significant contaminants across the site.

This comparison indicates that the data exceeds for the following inorganic compounds:

- Cadmium

It should be noted that the Tier I assessment criteria provides a conservative view, which may over-state the risk. Inorganic determinants identified above are of a general low solubility and therefore mobility, suggesting that these will not migrate to controlled water receptors. Furthermore, they may be representative of suspended solids within the water samples obtained rather than the true dissolved phase.

Given the site is underlain by granular material with a large quantity of low permeability cohesive Deposits within the matrix which will afford protection to the underlying Secondary A Aquifer; there is considered to be a low risk to controlled waters and the wider environ as no complete pollutant linkage can be determined. Furthermore, the nearest surface watercourse is the adjacent brook which, given the lack of mobile source contaminants is at a low risk.

Based on the above, there is considered to be no unacceptable level of risk to the controlled water receptors.

4.3 Ground Gas

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in CIEH Research Bulletin 17 *A Pragmatic Approach to Ground Gas Risk Assessment* (RB17).

This approach is considered appropriate given the age and limited thickness of Made Ground identified.

The desk-based analysis and subsequent ground investigation has identified the following potential sources of ground gas:

- No areas of discernible Made Ground present within on or immediately adjacent to the proposed development.
- No infilled ponds or features with potential decaying organic matter are identified;
- The site is not located within an area that is considered to be at risk from natural emission of Radon Gas.

Given the low sensitivity of the site with respect to hazardous ground gas, it was considered that a ground gas assessment undertaken in accordance with the latest guidance provided by CL:AIRE in their research bulletin RB17 would be suitable.

CL:AIRE Research Bulletin RB17 provides an alternative framework for the investigation and assessment of ground gas that takes into account other factors such as such as site history and the nature of the ground conditions beneath a site. It has been prepared to allow gas well installation and monitoring to be avoided where appropriate and may also be used in conjunction with gas monitoring to reduce the monitoring period or to avoid extra gas monitoring where anomalous results are recorded. The assessment is summarised in Table 4.5 below:

Table 4.5 RB17 Ground Gas Risk Assessment

E3P CL:AIRE RB 17 Ground Gas Risk Assessment			
Item	**Outcome**	**Action**	**Risk Score**
Have any credible OFF SITE ground gas sources been identified within the Desk Study & ICSM that would include: • ***Registered landfill within 250m;*** • ***Historical landfill;*** • ***Infilled pond within 50m;*** • ***Infilled ground 100m.***	No	None	1
Is the site located within close proximity to a variable groundwater regime (river or tidal) that could potentially influence the ground gas regime.	Yes	Chipping Brook along Northern boundary. But no gas source.	1
Has a credible pathway for the migration of gas from historical mine workings been identified.	No	None	1
Average depth of Made Ground >5.0m	No	None	1
Average depth Made Ground >3.0m	No	None	1
Average Depth Made Ground >1.0m	No	None	1
TOC <1	Yes	Natural (1 Sample)	1
TOC 1-3	Yes	Natural (2 Samples)	1
TOC >3	No	None	1
Made Ground In-situ >20 Years	No	None	1
Made Ground In-situ <20 Years	No	None	1
Only natural soils with no potential to generate CH4	Yes	None	1
Recorded coal gas emission	No	None	1
Radon Protection Measures Required	No	None	1
Risk Score			**14**

Notes for E3P RB17 Gas Risk Assessment

This risk assessment is an internal tool kit developed by E3P in due consideration of the guidance published within CL:AIRE RB17. The minimum score attributed is 1 with the assessment to be completed by a suitably qualified person deemed capable of making a reasoned and informed assessment.

Risk Score – 1 = Low / 2 = Moderate / 3 = High

Risk Profile

Cumulative risk score is **<15** the site is deemed to be very low risk and thus conforms to **Characteristic Situation 1.**
Cumulative risk score is **>15 but <20** the site is deemed to be low to medium risk and thus conforms to **Characteristic Situation 2.**
Cumulative risk score is **>20** the site is deemed to be medium to high risk and thus conforms to **Characteristic Situation 3.**

The RB17 assessment indicates a cumulative score of 15 and that suggests Characteristic Situation 1 of Green. It is considered that gas protection measures will not be required.

4.4 Conceptual Site Model

Following the completion of the intrusive site investigation, chemical analysis and risk assessment the conceptual model shown in Table 4.6 has been prepared for the site.

Table 4.6 Conceptual Model

SOURCE	PATHWAY	RECEPTOR
Human Health		
Heavy Metals and Non-Volatile PAHs	Dermal Contact and Ingestion Consumption of Homegrown Produce Soil Ingestion	Construction Workers Residential End Users
Discussion: Heavy metals and PAH's may pose a short term risk to construction workers who may come into contact with impacted soils during any future earthworks and future end used through direct contact and consumption of home grown produce. It is expected that during a phase of enabling works that this isolated occurrence is delineated, removed and validated to determine its future use within the development within an area of future low sensitivity or removal from site, thus breaking the pathway to the proposed end users.		
Controlled Waters		
Mobile Contaminants	Vertical / Lateral Migration	Chipping Brook
Discussion: The site is considered to be at no unacceptable level of risk to controlled water receptors.		
Ground Gas		
Methane and Carbon Dioxide	Inhalation & Accumulation	Construction Workers Site End Users
Discussion: The site can be classified as CS1/Green and no specialist mitigation measures will be required in the construction of the new development.		
Buildings and Infrastructure		
pH & Sulphate	Corrosion of Concrete	Foundations / Concrete
Discussion: Presence of pH and sulphate within deposits may result in corrosion of buried concrete within the proposed development. Assessment has been completed to confirm the levels of pH and sulphate meet the concrete classification of DS-1 AC-1s.		
Ecology		
None Identified	N/A	N/A
Discussion: In the absence of any potential receptors, no unacceptable risk to ecology has been identified.		

5. GEOTECHNICAL ASSESSMENT

5.1 Proposed Development

At this time, E3P has not been provided with a plot specific proposed development plan however, it is expected that the development will feature a number of low rise residential properties comprising residential dwellings of mixed type with associated gardens, estate roads and infrastructure.

5.2 Summary of Ground Conditions

Made Ground

Made Ground has not been encountered within any exploratory hole locations during the investigation. Due to the lack of historic development across the site this is also not expected.

Drift

Drift deposits were encountered within all exploratory locations to depths of between 0.20m and in excess of 4.0m bgl. The drift deposits are generally consistent and comprise a dark brown sandy silty clayey GRAVEL of sandstone, mudstone and limestone. Generally, with depth the size and content of the granular components increases with boulders becoming more frequent.

There is also localised yellowish brown sandy gravelly CLAY to depths between 0.2 and in excess of 1.0m in window samples and trial pits in the west and south of the site. This is also locally interbedded with the dark brown clayey GRAVEL and Gravelly CLAY.

Solid

The solid bedrock geology has not been encountered due to obstructions in the form of oversize boulders at depths in excess of 6m bgl stopping the penetration of drilling and testing equipment. The use of a Super Heavy Dynamic Probe test advanced the investigation to a depth of 13.0m bgl however, again refusal in dense gravels and obstructions ceased progress. The solid geology is indicated to comprise limestone bedrock from BSG information, however, boreholes scans in the area show Millstone Grit (Carboniferous Sandstone) from 15.00m bgl.

5.3 Site Preparation

The site should be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the Specification for Highway Works. This should include:

- Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infiled with suitable compacted engineered fill;
- Any redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill; and,
- Buried structures and old foundations have not been encountered on site. However, given the glacial deposits in the area oversize boulders can be potentially present. These should be excavated from below the proposed development foot print with the resulting void backfilled.

5.4 Foundation Conditions & Assessment of Potential Bearing Capacities

In due consideration of the identified ground conditions, in-situ and laboratory geotechnical testing, E3P has undertaken an assessment of the net safe Allowable Bearing Pressure (ABP) within the underlying natural stratum to assist in the detailed design of foundations and infrastructure and determine the target founding stratum. The assessment of ABP is summarised in Table 5.1.

Table 5.1 Summary of ABP Assessment

GRANULAR SOILS			
Description	**Depth (range bgl)**	**Relative Density**	**Allowable Bearing Pressure (kN/m²)**
Clayey GRAVEL	1.00-1.45	Medium – Very Dense	*131 - 504*
	2.00-2.45	Medium Dense - Dense	*191 - 456*
	3.00-3.45	Medium Dense	*269 - 278*
	4.00-4.45	Dense	*422*

Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe net Allowable Bearing Potential, the suitable target founding stratum has been identified as the underlying medium dense Gravel.

However, given the significant topographical variances on the site, prior to the detailed design of suitable foundations solutions, a programme of site enabling works will be required to provide suitable development platform levels.

Therefore, upon completion of these enabling works, it is likely that the most cost effective option for the majority of the site would be to support a traditional strip footing in the medium dense gravel at shallow depth.

The option to this would be a pier and beam system utilising concrete rings to form the foundation.

Given the nature of the site and proposed detached bespoke dwellings it will be necessary for the project Structural Engineer to design specific foundations for each dwelling considering the proposed floor levels, sub-structure design and post enabling works ground conditions.

Table 5.2 Anticipated Foundations

LOCATION	ANTICIPATED FOUNDING STRATA DEPTH	GROUND WATER	FOUNDATION TYPE	TYPE OF CONCRETE	REMARKS
WS101A	1.15	N/A	Strip/Pier and Beam	DS-1 AC-1s	VSC to Competent strata
WS101B	0.75	N/A	Strip/Pier and Beam	DS-1 AC-1s	
WS101C	0.75	N/A	Strip/Pier and Beam	DS-1 AC-1s	
WS102	0.75	N/A	Strip/Pier and Beam	DS-1 AC-1s	
WS103A	0.75	N/A	Strip/Pier and Beam	DS-1 AC-1s	
WS103B	0.75	N/A	Strip/Pier and Beam	DS-1 AC-1s	
WS103C	0.75	N/A	Strip/Pier and Beam	DS-1 AC-1s	
WS104A	0.75	N/A	Strip/Pier and Beam	DS-1 AC-1s	
WS104B	0.85	N/A	Strip/Pier and Beam	DS-1 AC-1s	
TP101	0.85	N/A	Strip/Pier and Beam	DS-1 AC-1s	

TP102	0.75	N/A	Strip/Pier and Beam	DS-1 AC-1s	
TP103	1.35	N/A	Strip/Pier and Beam	DS-1 AC-1s	
TP104	0.75	N/A	Strip/Pier and Beam	DS-1 AC-1s	
TP105	0.85	N/A	Strip/Pier and Beam	DS-1 AC-1s	
TP106	1.15	N/A	TF/Pier and Beam	DS-1 AC-1s	
TP107	1.55	1.30	TF/Pier and Beam	DS-1 AC-1s	
TP108	2.15	0.90 1.40 2.00	TF/Pier and Beam	DS-1 AC-1s	

Foundation depths should take account of the presence of existing and proposed trees with foundations deepened locally, to mitigate the potential for volumetric instability attributed to fluctuations in moisture content, in accordance with the requirements of NHBC standards.

At this time, it is not possible to accurately define the foundation types due to the absence of a detailed tree survey and final development levels and slope stability assessment, however based on our extensive experience of similar sites we would anticipate that the final foundation solution would be a combination of the following:

- *Shallow strip and trench fill foundations bearing on medium dense gravel at c 1.0-2.50m bgl; and,*
- *Pier and beam to support re-enforced strip foundations in areas of variable ground.*

A conjectured depth to founding strata from current ground level Plan is included as Drawing 12-424-006 in Appendix III.

5.5 Ground Floor Slabs

Current building control regulations require that where infilled ground is present to depths in excess of 600mm or where the sub-stratum is variable in terms of the structure and settlement potential or where clay soils are present within the influence of existing or proposed trees, a suspended floor slab is required.

In this instance it is considered that for the majority of substructures, the underlying stratum would have a variable sub-stratum due to the high clay content within the granular stratum and as such a suspended floor slab will be required.

Where a cast in-situ suspended slab is utilised with no sub-floor void, appropriate compressible material (heave precautions) will be required in the construction of the sub-structure.

5.6 Heave Precautions

The site has been proven to be underlain by predominantly granular soils with clay matrix. Given their classification these soils are not susceptible to volumetric instability due to fluctuations in moisture content as per the NHBC / LABC conjectured zones of influence.

5.7 Pavement Construction

A programme of remediation and enabling works will be required to remediate the proposed road sub-grade in accordance with the requirements of the highways design manual (series 600) for a Method Compaction.

It is considered that the material can be re-engineered to a method to achieve a CBR in excess of 5% if works are completed in favourable climatic conditions.

5.8 Drainage

The presence of substantial depths of clay bound gravel across the site may result in settlement. It is therefore recommended that drain runs are designed using steeper gradients and flexible joints to allow for some differential settlement.

Furthermore, the use of soak-away drainage will be limited, and as the lateral continuity of the clay component cannot be assured it is not recommended that soakaways utilised for disposal of surface water runoff.

If soak-away drainage is to be considered, full BRE365 Testing must be completed to inform the detailed design.

5.9 Concrete Durability

Based upon the results of the chemical analyses summarised in it is considered that subsurface concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with the recommendations provided in BRE Special Digest 1 (2005).

5.10 Excavations

Trial Pits were generally stable in natural strata, as such it is considered that near surface excavations will be feasible. Areas where excavation exceeded 2.00m, excavations were generally less stable.

Site observations indicated that excavations should be feasible in the near surface with normal plant. It is anticipated that any obstructions will be grubbed out during the reduced level dig for the sub structure works.

However, due to the depth and variability of the natural deposits and likelihood of trench collapse it is considered that all excavations are supported or battered back in accordance with guidance contained in CIRIA R97.

If local pumping of groundwater is required during the advancement of excavations for the proposed foundations. Consideration should be given for the potential for dewatering gravels in the surrounding areas to the subject site that may cause structural damage to buildings sub-structures in close proximity to the site.

Table 5.4 Civil Engineering Excavation Risk Matrix

Risk Item	Present	Comment
Running Sands	No	N/A
Minor Water ingress	No	Minor water ingress will require localised dewatering / sump pumping during the construction of site drainage infrastructure. Ingress of water into foundation excavation will potentially flood foundation excavations limiting the viability of spread foundations to be constructed.
Shallow Bedrock	No	N/A

5.11 Slope Stability

A significant embankment is present at the northern and southern boundary leading to Chipping Brook (north) and Church Raike (Road – south) at the lower elevation of these slopes.

As and when detailed topographic information is available and in due consideration of the proposed development design, structural and infrastructure loading, a detailed slope stability model will be required. This model will seek to determine the potential for newly imposed loadings to generate a risk of instability or failure within the off-site embankment and the need for any mitigation measures such as piled foundation to transfer loadings below the base of the slope.

5.12 Further Works

Based on the findings of the intrusive site investigation, the following additional works are recommended to be completed in due course:

- Plot Specific Foundation Schedule (upon receipt of the final development levels);
- Arboricultural Survey;
- Slope stability assessment;
- Geotechnical Earthworks Strategy (Infrastructure);
- Remediation & Enabling Works strategy

5.13 Construction Activity and Inspection

The following activities and inspections should be incorporated in to the site works:

- Due to the variability of the soils at the site it is recommended that sufficient allowance is made for the inspection of formation and sub formations to foundations and pavement construction;
- Excavations where access is required should be subject to a risk assessment from a competent person and where appropriate mitigation measures such as benching back the sides or use of support systems in accordance with CIRIA R97 utilised;
- It is considered that de-watering may be required, especially following periods of heavy rainfall. Removal of surface water and water within trenches should be possible with conventional sump pumping. Discharge of any water should be agreed with the relevant regulatory body and be undertaken under a trade effluent discharge, where required. Measures to remove silt and suspended solids may be required and consideration should be given to provision of space for settling tanks or an attenuation pond;
- The presence of potential contamination and mitigation measures should be addressed as part of the Construction Stage Health and Safety Plan and should include measures to design out the risks, reduce their impact and finally the use of Personnel Protective Equipment (PPE).

6. CONCLUSIONS AND RECOMMENDATIONS

Contaminated Land	
Human Health	The Tier 1 Human Health Risk Assessment identified an isolated concentration of non-volatile organic compounds that would present unacceptable degree of theoretical risk to the identified receptors associated with direct exposure pathways. Given the identified depth of this exceedance (0.2m bgl) it is likely the material will be processed in a hotspot removal during initial enabling works. In this circumstance as it is an isolated occurrence the materials should be delineated, removed and validated to ensure removal from site or placement in an area of low future risk and therefore breaking the pathway to future end users. This method would negate the use of a cover system and ensure the re-use of other topsoil across site that has been confirmed to be suitable within the proposed development. Natural granular drift strata has been confirmed as suitable for reuse within the future development.
Controlled Waters	Low risk to controlled waters.
Ground Gas	Characteristic Situation 1 / Green
Potable Water	Poly-Ethylene Pipe

Geotechnical Issues

No anthropogenic obstructions have been identified within the intrusive investigation however, given the increasing granular nature of the soils and increase size and volume with depth is it expected that some larger boulders will require removal during the excavation for foundations the road box and any sub surface utility construction.

The underlying natural granular drift deposits have been assessed as being medium dense to dense with a net ABP in the order of 150kN/m2 at circa 1.00m bgl increasing to in excess of 150-200kN/m2 with depth.

Due to the existing large variances in the site topography, a phase of cut and fill enabling works will be required in order to create a proposed development platform suitable for a residential development. This will generally comprise increasing levels on the road side to the south and east.

Given that competent strata has been identified in the near surface it is expected that traditional shallow strip foundations will be suitable for the construction of most plots.

Where target strata is found at greater depth it may be suitable to facilitate the use of pier and beam foundations to support a reinforced strip footing.

Given the nature of the site and proposed detached bespoke dwellings it will be necessary for the project Structural Engineer to design specific foundations for each dwelling considering the proposed floor levels, sub-structure design and post enabling works ground conditions.

END OF REPORT

APPENDIX I
LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between E3P and the Client as indicated in Section 1.2.

2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.

3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.

4. During the site walkover reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not be made known or accessible.

5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.

6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.

7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials this is for indicative purposes only and do not constitute or replace full and proper surveys.

8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

9. E3P cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by E3P is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by E3P in this connection without their explicit written agreement there to by E3P.

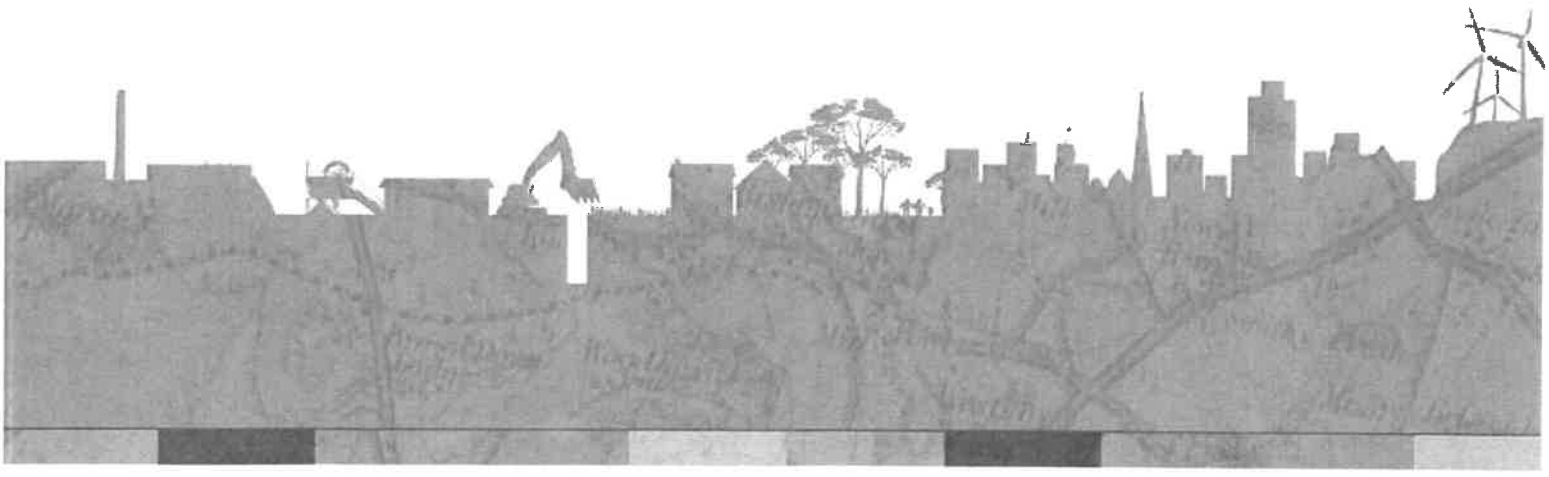
10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

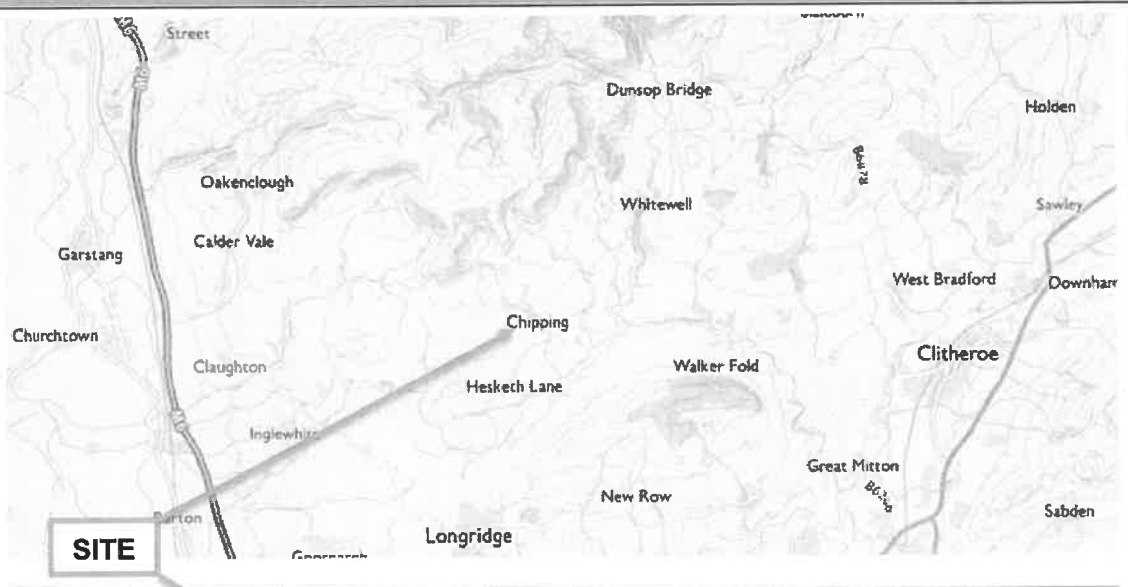
APPENDIX II
GLOSSARY

TERMS

AST	Above Ground Storage Tank	**SGV**	Soil Guideline Value
BGS	British Geological Survey	**SPH**	Separate Phase Hydrocarbon
BSI	British Standards Institute	**TPH CWG**	Total Petroleum Hydrocarbon (Criteria Working Group)
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes	**SPT**	Standard Penetration Test
CIEH	Chartered Institute of Environmental Health	**SVOC**	Semi Volatile Organic Compound
CIRIA	Construction Industry Research Association	**UST**	Underground Storage Tank
CLEA	Contaminated Land Exposure Assessment	**VCCs**	Vibro Concrete Columns
CSM	Conceptual Site Model	**VOC**	Volatile Organic Compound
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)	**WTE**	Water Table Elevation
DWS	Drinking Water Standard	**m**	Metres
EA	Environment Agency	**km**	Kilometres
EQS	Environmental Quality Standard	**%**	Percent
GAC	General Assessment Criteria	**%v/v**	Percent volume in air
GL	Ground Level	**mb**	Milli Bars (atmospheric pressure)
GSV	Gas Screening Value	**l/hr**	Litres per hour
HCV	Health Criteria Value	**µg/l**	Micrograms per Litre (parts per billion)
ICSM	Initial Conceptual Site Model	**ppb**	Parts Per Billion
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene)	**mg/kg**	Milligrams per kilogram (parts per million)
ND	Not Detected	**ppm**	Parts Per Million
LMRL	Lower Method Reporting Limit	**mg/m^3**	Milligram per metre cubed
NR	Not Recorded	**m bgl**	Metres Below Ground Level
PAH	Polycyclic Aromatic Hydrocarbon	**m bcl**	Metre Below Cover Level
PCB	Poly-Chlorinated Biphenyl	**mAOD**	Metres Above Ordnance Datum (sea level)
PID	Photo Ionisation Detector	**kN/m^2**	Kilo Newtons per metre squared
QA	Quality Assurance	**µm**	Micro metre
SGV	Soil Guideline Value		

APPENDIX III
DRAWINGS





Drawing 12-424-001

Site Location Plan

e3p

Key:

Notes:

P1	-	25-05-2018	DRAFT	CB	MD
Phase	Revision	Date	Issue	Drawn	Authorised

Client: Chipping Homes Ltd

Job No: 12-424

Date: 25-05-2018

Drawing No: 002

Scale: NTS

Job Title: Chipping Parcel 4

Drawing Title: Indicative Masterplan

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E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

Key:

Historical Features

Unspecified Building (Pre 1891 - Pre 2018)

Field Boundary (Pre 1891 - Pre 2018)

Notes:

P1	-	25-05-2018	DRAFT	CB	MD
Phase	Revision	Date	Issue	Drawn	Authorised

Client: Chipping Homes Ltd

Job No: 12-424

Date: 25-05-2018

Drawing No: 003

Scale: NTS

Job Title: Chipping Parcel 4

Drawing Title: Historical Features Plan

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Website: www.e3p.co.uk

Key:

Location Symbols

- WS101 — Approximate Window Sample Probehole Location
- BH101 — Approximate Cable Percussive Borehole Location
- TP101 — Approximate Trial Pit Location
- SHDP — Super Heavy Dynamic Probing

Legend

- Development Area

Notes:

Phase	Revision	Date	Issue	Drawn	Authorised
P1	R3	21.05.2018	REVISION	HM	MD
P1	R2	20.04.2018	REVISION	CB	MD
P1	R1	10.04.2018	REVISION	RW	MD
P1	-	26.03.2018	DRAFT	HM	MD

Client: Chipping Homes Ltd

Job No: 12-424

Date: 21.05.2018

Drawing No: 004

Scale: NTS

Job Title: Chipping Parcel 4

Drawing Title: Exploratory Hole Location Plan

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Key:

Location Symbols

- WS101 — Approximate Window Sample Probehole Location
- TP101 — Approximate Trial Pit Location
- HP101 — Approximate Hand Dug Pit Location
- CP101 — Approximate Cable Percussive Borehole Location
- RB101 — Approximate Rotary Borehole Location
- CBR101 — Approximate California Bearing Ratio Test Location
- DCP101 — Approximate Dynamic Cone Penetrometer Test Location

Legend

- Development Area

Made Ground Depth (m)

- Made Ground in Excess of 2.00m
- Depth of Made Ground Between 1.80 - 1.99m
- Depth of Made Ground Between 1.60 - 1.79m
- Depth of Made Ground Between 1.40 - 1.59m
- Depth of Made Ground Between 1.20 - 1.39m
- Depth of Made Ground Between 1.00 - 1.19m
- Depth of Made Ground Between 0.80 - 0.99m
- Depth of Made Ground Between 0.60 - 0.79m
- Depth of Made Ground Between 0.40 - 0.59m
- Depth of Made Ground Between 0.20 - 0.39m
- Depth of Made Ground Between 0.00 - 0.19m

Notes:

The conjectured depth mapping has been completed using 3D modelling software to produce indicative assessments that at this time are the most accurate interpretation of the Ground Investigation data. However, the conjectured nature of the model, limitations and areas of uncertainty between two proven points and the intermediary area result in uncertainties that should be considered by the reader of a drawing and incorporated in any subsequent assessment.

Phase	Revision	Date	Issue	Drawn	Authorised
P1	-	24.05.2018	DRAFT	HM	MD

Client: Chipping Homes Ltd

Job No: 12-424

Date: 24.05.2018

Drawing No: 005

Scale: NTS

Job Title: Chipping Parcel 4

Drawing Title: Depth of Topsoil Plan

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Key:

Location Symbols

- WS101 — Approximate Window Sample Probehole Location
- BH101 — Approximate Cable Percussive Borehole Location
- TP101 — Approximate Trial Pit Location
- SHDP — Super Heavy Dynamic Probing

Legend

- Development Area

Shallow Spread Footings

- Depth to Founding Strata 0.00 - 1.24m
- Depth to Founding Strata 1.25 - 1.49m

Mass Trench Fill Footings

- Depth to Founding Strata 1.50 - 1.74m
- Depth to Founding Strata 1.75 - 1.99m
- Depth to Founding Strata 2.00 - 2.24m

Engineered Footings

- Depth to Founding Strata 2.25 - 2.49m
- Depth to Founding Strata >2.50m

Notes:

The conjectured depth mapping has been completed using 3D modelling software to produce indicative assessments that at this time are the most accurate interpretation of the Ground Investigation data. However, the conjectured nature of the model, limitations and areas of uncertainty between two proven points and the intermediary area result in uncertainties that should be considered by the reader of a drawing and incorporated in any subsequent assessment.

Phase	Revision	Date	Issue	Drawn	Authorised
P1	-	25-05-2018	DRAFT	CB	MD

Client: Chipping Homes Ltd

Job No: 12-424

Date: 25-05-2018

Drawing No: 006

Scale: NTS @ A3

Job Title: Chipping Parcel 4

Drawing Title: Depth to Founding Strata Plan

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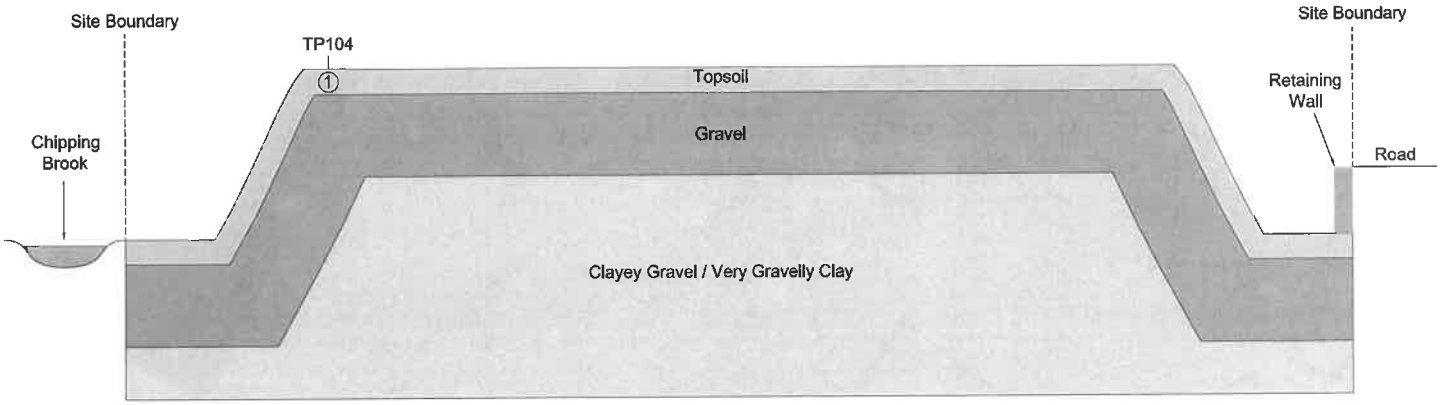
ID	SOURCE	EXPOSURE	Potential Pathway
HUMAN HEALTH			
1	Heavy Metals, heavy end Hydrocarbons & Non Volatile Polycyclic Aromatic Hydrocarbon (PAH)	Dermal Contact and Ingestion Consumption of Home-grown Produce	Construction Workers & Residential End Users
2	Semi Volatile Polycyclic Aromatic, and petroleum and diesel range hydrocarbon Compounds, Chlorinated Hydrocarbons	Volatilisation / Accumulation, Vapour Inhalation	Construction Workers & Residential End Users
3	Asbestos Containing Materials (ACM)	Fibre / Dust Inhalation	Construction Workers, Residential End Users &Third Party Property
4	Hazardous Ground Gases	Inhalation Accumulation	Construction Workers Residential End Users
5	PCBs	Dermal Contact and Ingestion Consumption of Home-grown Produce	Construction Workers & Residential End Users
CONTROLLED WATERS			
6	Water Soluble Mobile Contaminants	Vertical Migration	Secondary Aquifer
7	Water Soluble Mobile Contaminants	Lateral Migration	Surface Water Courses
BUILDING & INFRASTRUCTURE			
8	pH & Sulphate	Corrosion of Concrete	Foundations - Capacity
9	VOC, TPH's Phenols, H	Chemical Corrosion	Potable Water Supply

Key:



Notes:

Phase	Revision	Date	Issue	Drawn	Authorised
P1	-	25-05-2018	DRAFT	CB	MD

Client: Chipping Homes Ltd	Job No: 12-424	Date: 25-05-2018
	Drawing No: 007	Scale: NTS @ A3
Job Title: Chipping Parcel 4	Drawing Title: Conceptual Site Model	

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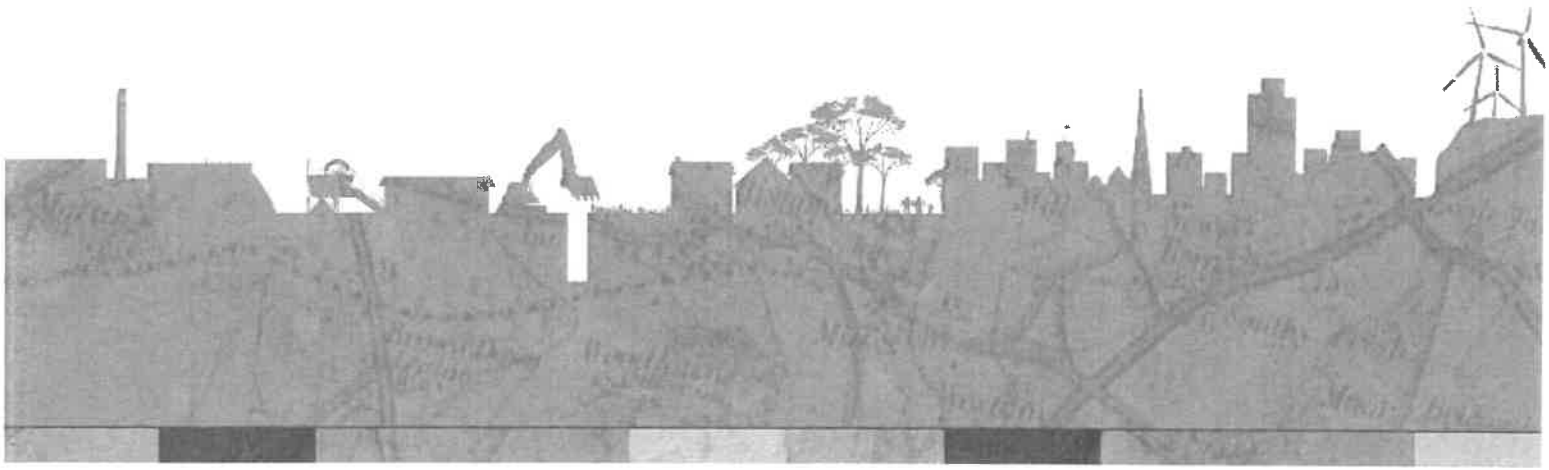
APPENDIX IV
E3P EXPLORATORY HOLE LOGS



Trial Pit Log

Trialpit No: TP101
Sheet 1 of 1

Project Name:	Chipping- Parcel 4	Project No. 12424	Co-ords: - Level:
Location:	Preston	Dimensions (m): Depth 3.20	2.00 × 0.60
Client:	Chadkirk Consulting		Date 19/04/2018; Scale 1:25; Logged S. Murray

Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
Depth	Type	Results				
0.30	ES		0.50			Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
2.00	ES		3.20			Dark brown black slightly sandy clayey silty GRAVEL. Gravel is fine to coarse angular to rounded of mudstone, sandstone and limestone.
						End of pit at 3.20 m

1 2 3 4 5

Remarks: Complete.

Stability: Stable.

Trial Pit Log

Trialpit No: TP102
Sheet 1 of 1

Project Name:	Chipping- Parcel 4	Project No. 12424	Co-ords: - Level:
Location:	Preston	Dimensions (m): 2.00 × 0.60, Depth 3.40	Date 19/04/2018
Client:	Chadkirk Consulting		Scale 1:25, Logged S. Murray

Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
Depth	Type	Results				
0.20	ES		0.20			Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
			0.40			Brown slightly sandy clayey GRAVEL. Gravel is fine to coarse angular to rounded of mudstone, sandstone and limestone.
1.50	B					Dark brown clayey GRAVEL. Gravel is fine to coarse angular to rounded of sandstone, mudstone and limestone.
			3.40			End of pit at 3.40 m

Remarks: Complete.

Stability: Stable.

Trial Pit Log

Trialpit No: TP103

Sheet 1 of 1

Project Name:	Chipping- Parcel 4	Project No. 12424	Co-ords: - Level:
Location:	Preston	Dimensions (m): Depth 2.90	2.00 × 0.60
Client:	Chadkirk Consulting		Date 19/04/2018; Scale 1:25; Logged S. Murray

Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
Depth	Type	Results				
			0.20			Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
0.40	ES	HP=39				Soft low strength yellow brown sandy gravelly CLAY. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
		HP=29	1.00			Dark brown black slightly sandy silty clayey GRAVEL. Gravel is fine to coarse sub-angular to sub-rounded of mudstone, sandstone and limestone.
1.50	ES					
			2.90			End of pit at 2.90 m

1 2 3 4 5

Remarks: Complete.

Stability: Stable.

Trial Pit Log

Trialpit No: **TP104**

Sheet 1 of 1

Project Name:	Chipping- Parcel 4	Project No.: 12424	Co-ords: - Level:
Location:	Preston	Dimensions (m): 2.00 x 0.60 Depth 3.00	Date: 19/04/2018 Scale: 1:25
Client:	Chadkirk Consulting		Logged: S. Murray

Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
Depth	Type	Results				
0.20	ES		0.30			Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
						Dark brown black sandy clayey silty GRAVEL. Gravel is fine to coarse angular to rounded of mudstone, sandstone and limestone.
			1.60			Stiff high strength dark brown black very gravelly CLAY. Gravel is fine to coarse angular to rounded of mudstone, sandstone and mudstone.
2.00	ES	HP=206				
		HP=216				
			3.00			End of pit at 3.00 m

Remarks: Complete.

Stability: Stable.

Trial Pit Log

Trialpit No: TP105
Sheet 1 of 1

Project Name: Chipping- Parcel 4	Project No. 12424	Co-ords: - Level:	Date 19/04/2018
Location: Preston		Dimensions (m): Depth 2.80, 2.00, 0.60	Scale 1:25
Client: Chadkirk Consulting			Logged S. Murray

Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
Depth	Type	Results				
						Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
			0.40			
0.50	ES	HP=98				Yellow brown silty sandy clayey GRAVEL Gravel is fine to coarse angular to rounded of sandstone and limestone.
			1.20			
2.00	ES					Dark brown very sandy clayey GRAVEL with pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of mudstone, sandstone and limestone.
			2.80			End of pit at 2.80 m

1 2 3 4 5

Remarks: Complete.

Stability: Stable.

Trial Pit Log

Trialpit No: **TP106**

Sheet 1 of 1

Project Name: Chipping- Parcel 4	Project No. 12424	Co-ords: - Level:	Date 19/04/2018
Location: Preston		Dimensions (m): 2.00 x 0.60 Depth 3.10	Scale 1:25
Client: Chadkirk Consulting			Logged S. Murray

Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
Depth	Type	Results				
0.30	ES		0.80			Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
2.00	B					Dark brown black slightly sandy silty clayey GRAVEL with pockets of gravelly sand. Gravel is fine to coarse angular to rounded of sandstone and limestone.
2.50	ES		3.10			End of pit at 3.10 m

Remarks: Complete.

Stability: Stable.

Trial Pit Log

Trialpit No: TP107
Sheet 1 of 1

Project Name: Chipping- Parcel 4	Project No. 12424	Co-ords: - Level:	Date 19/04/2018
Location: Preston		Dimensions (m): Depth 3.50	2.00 / 0.60	Scale 1:25
Client: Chadkirk Consulting			Logged S. Murray

Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
Depth	Type	Results				
0.20	ES					Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
		HP=42	0.60			Soft to firm low to medium strength brown slightly sandy silty gravelly CLAY with pockets of yellow orange sand. Gravel is fine to coarse angular to rounded of mudstone, sandstone and limestone.
		HP=29				
			1.20			Dark brown black sandy silty clayey GRAVEL with pockets of orange yellow fine to medium sand. Gravel is fine to coarse angular to rounded of mudstone, sandstone and limestone.
1.50	ES					
			2.00			Dark black brown silty clayey GRAVEL. Gravel is fine to coarse angular to rounded of sandstone, mudstone and limestone.
2.20	ES					
		HP=201				
		HP=206				
			3.50			End of pit at 3.50 m

Remarks: 1. Complete. 2. Water strike encountered at 1.30m bgl- slow seepage.

Stability: Stable.

Trial Pit Log

Trialpit No **TP108** Sheet 1 of 1

Project Name: Chipping- Parcel 4	Project No. 12424	Co-ords: - Level:	Date 19/04/2018
Location: Preston		Dimensions (m): 2.00 × 0.60 Depth 3.50	Scale 1:25
Client: Chadkirk Consulting			Logged S. Murray

Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
Depth	Type	Results				
0.20	ES		0.30			Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
		HP=81	0.90			Stiff high strength yellow brown sandy gravelly CLAY with pockets of yellow fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and limestone.
		HP=27	1.80			Soft low strength dark brown black sandy silty gravelly CLAY. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
2.00	ES		3.50			Dark brown black sandy silty clayey GRAVEL with pockets of gravelly clay. Gravel is fine to coarse angular to rounded of limestone. and sandstone.
						End of pit at 3.50 m

Remarks: 1. Complete. 2. Water strike encountered at 0.90m, 1.40m and 2.00m bgl.

Stability: Stable.

Borehole Log

Borehole No. **WS101a**

Sheet 1 of 1

Project Name: Chipping- Parcel 4	Project No.: 12424	Co-ords: -	Hole Type: WS
Location: Preston		Level:	Scale: 1:50
Client: Chadkirk Consulting		Dates: 18/04/2018 -	Logged By: S. Murray

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	ES					Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
		0.50	PP	56	0.40			
		0.50	ES					Medium dense yellow brown sandy gravelly CLAY. Gravel is fine to medium angular to rounded of mudstone and sandstone.
		0.90	PP	15 N=14 (3,4/4,3,4,3)	0.80			
		1.20	PP	15				Dense dark grey mottled brown slightly sandy silty very clayey GRAVEL. Gravel is fine to medium angular to rounded of mudstone, sandstone and rare limestone.
		1.50	ES					
		1.80	PP	157				
				50 (0 for 0mm/50 for 20mm)	2.00			End of borehole at 2.00 m

Remarks

Refused on assumed cobbles at 2.00m bgl.

Borehole Log

Borehole No. **WS101b**

Sheet 1 of 1

Project Name: Chipping- Parcel 4	Project No.: 12424	Co-ords: -	Hole Type: WS
Location: Preston		Level:	Scale: 1:50
Client: Chadkirk Consulting		Dates: 18/04/2018 -	Logged By: S. Murray

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.40	ES		0.20			Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
		1.20	ES	50 (12,11/50 for 20mm)	1.00			Brown sandy clayey GRAVEL. Gravel is fine to medium angular to rounded of sandstone and mudstone.
					2.00			Very dense dark brown slightly sandy silty clayey GRAVEL. Gravel is fine to medium angular to rounded of mudstone, sandstone and rare limestone.
								End of borehole at 2.00 m

Remarks

1. Refused at 2.00m bgl. 2. Monitoring well installed.

Borehole Log

Borehole No. **WS101c**

Sheet 1 of 1

Project Name: Chipping- Parcel 4	Project No.: 12424	Co-ords: -	Hole Type: WS
Location: Preston		Level:	Scale: 1:50
Client: Chadkirk Consulting		Dates: 18/04/2018 -	Logged By: S. Murray

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.20			Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
					1.00			Brown sandy clayey GRAVEL. Gravel is fine to medium angular to rounded of sandstone and mudstone.
					2.00			Dark brown slightly sandy silty clayey GRAVEL. Gravel is fine to medium angular to rounded of mudstone, sandstone and rare limestone.
								End of borehole at 2.00 m

Remarks

Refused at 2.00m bgl.

Borehole Log

Borehole No. **WS102**

Sheet 1 of 1

Project Name: Chipping- Parcel 4	Project No.: 12424	Co-ords: -	Hole Type: WS
Location: Preston		Level:	Scale: 1:50
Client: Chadkirk Consulting		Dates: 18/04/2018 -	Logged By: S. Murray

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.20	ES		0.30			Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
		0.50	PP	91				
		0.80	ES	N=13 (2,3/3,4,3,3)				Medium dense brown sandy silty clayey GRAVEL. Gravel is fine to medium angular to rounded of mudstone, sandstone and limestone.
		1.20	PP	22	1.40			
		1.80	PP	221				Medium dense dark brown black silty clayey GRAVEL. Gravel is fine to medium angular to rounded of mudstone, sandstone and rare limestone.
				N=21 (6,3/3,4,7,7)	2.30			
				N=32 (7,7/8,7,9,8)				Medium dense dark brown black silty clayey GRAVEL. Gravel is fine to medium angular to rounded of sandstone, mudstone and limestone.
		3.50	ES		3.20			
		3.80	PP	221				Dense dark brown black clayey silty GRAVEL. Gravel is fine to medium angular to rounded of mudstone, sandstone and limestone.
				50 (10,14/50 for 35mm)	4.00			End of borehole at 4.00 m

Remarks

Refused at 4.00m bgl on assumed cobbles.

Borehole Log

Borehole No. **WS103a**

Sheet 1 of 1

Project Name: Chipping- Parcel 4	Project No.: 12424	Co-ords: -	Hole Type: WS
Location: Preston		Level:	Scale: 1:50
Client: Chadkirk Consulting		Dates: 18/04/2018 -	Logged By: S. Murray

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.20	ES		0.30			Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
		0.50	PP	152				Brown slightly sandy clayey silty GRAVEL. Gravel is fine to medium angular to sub-angular of mudstone, sandstone and limestone.
		0.80	PP	98				
		0.80	ES	N=24 (5,4/4,4,7,9)				
					2.00			End of borehole at 2.00 m

Remarks

Refused at 2.00m bgl on assumed cobbles.

Borehole Log

Borehole No. **WS103b**

Sheet 1 of 1

Project Name: Chipping- Parcel 4	Project No.: 12424	Co-ords: -	Hole Type: WS
Location: Preston		Level:	Scale: 1:50
Client: Chadkirk Consulting		Dates: 18/04/2018 -	Logged By: S. Murray

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.50	PP	71	0.30			Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
		0.50	ES					
		1.20	PP	50 (11,13/50 for 15mm) 34	1.30			Very dense brown slightly sandy clayey GRAVEL Gravel is fine to medium angular to rounded of sandstone, mudstone and limestone.
		1.80	PP	221				Dark brown black silty clayey GRAVEL. Gravel is fine to medium sub-angular to rounded of sandstone and mudstone.
		1.80	ES		2.00			End of borehole at 2.00 m

Remarks

Refused on assumed cobble at 2.00m bgl.

Borehole Log

Borehole No. **WS103c**

Sheet 1 of 1

Project Name: Chipping- Parcel 4	Project No.: 12424	Co-ords: -	Hole Type: WS
Location: Preston		Level:	Scale: 1:50
Client: Chadkirk Consulting		Dates: 18/04/2018 -	Logged By: S. Murray

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.20	ES		0.40			Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
		0.70	PP	152				Brown slightly sandy silty clayey GRAVEL. Gravel is fine to medium angular to rounded of mudstone, sandstone and limestone.
		0.80	ES		1.00			End of borehole at 1.00 m

Remarks

Refused at 1.00m bgl on assumed cobbles.

Borehole Log

Borehole No. **WS104a**

Sheet 1 of 1

Project Name: Chipping- Parcel 4	Project No.: 12424	Co-ords: -	Hole Type: WS
Location: Preston		Level:	Scale: 1:50
Client: Chadkirk Consulting		Dates: 18/04/2018 -	Logged By: S. Murray

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.60 0.70	ES PP	132 N=23 (4,5/6,6,5,5,6) 54 (25 for 95mm/54 for 10mm)	0.20			Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
								Medium dense to dense yellow brown slightly sandy clayey GRAVEL. Gravel is fine to medium angular to rounded of mudstone, sandstone and mudstone.
					2.00			End of borehole at 2.00 m

Remarks

Refused at 2.00m bgl on assumed cobbles.

Borehole Log

Borehole No. **WS104b**

Sheet 1 of 1

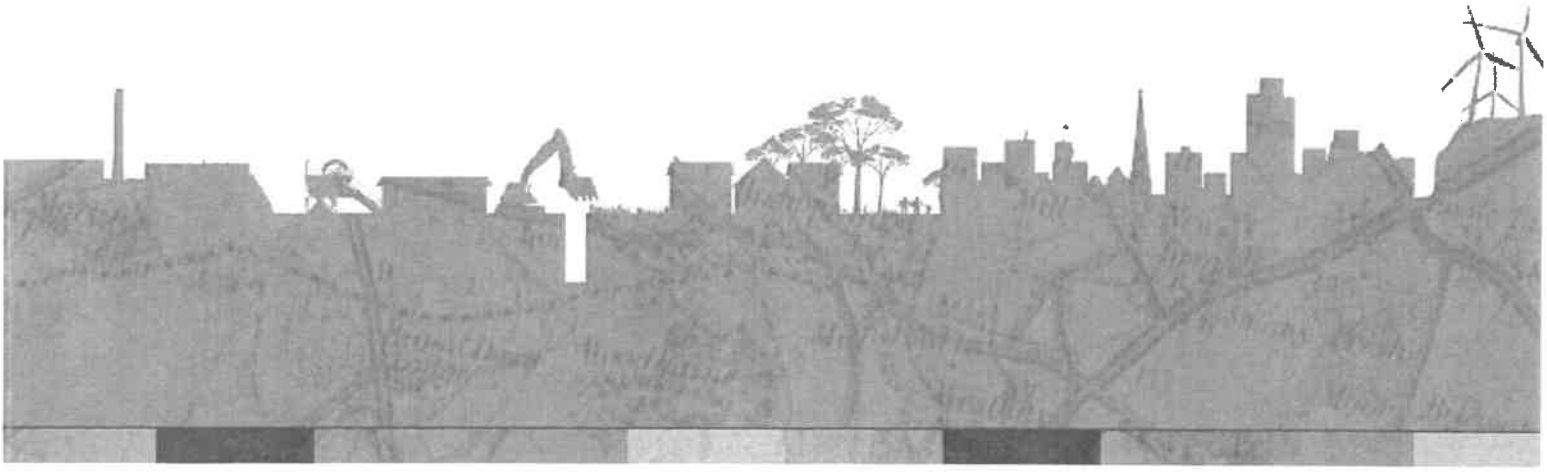
Project Name: Chipping- Parcel 4	Project No.: 12424	Co-ords: -	Hole Type: WS
Location: Preston		Level:	Scale: 1:50
Client: Chadkirk Consulting		Dates: 18/04/2018 -	Logged By: S. Murray

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.50	PP	80	0.50			Brown slightly sandy clayey GRAVEL (Topsoil) with rootlets and pockets of orange fine to medium sand. Gravel is fine to coarse angular to rounded of sandstone and mudstone.
		0.60	ES					
		0.80	PP	140				Medium dense yellow brown slightly sandy clayey GRAVEL. Gravel is fine to medium angular to rounded of mudstone and sandstone.
				N=22 (6,5/5,5,5,7)	1.10			
		1.20	PP	142				Medium dense sandy clayey GRAVEL. Gravel is fine to medium angular to rounded of mudstone, sandstone and mudstone.
		1.80	PP	201				
				N=29 (5,6/6,8,7,8)	2.00			Medium dense dark brown black slightly sandy clayey GRAVEL. Gravel is fine to medium angular to rounded of mudstone, sandstone and rare mudstone.
		2.70	PP	221				
		2.80	ES					
				N=31 (6,6/6,8,9,8)	3.00			End of borehole at 3.00 m

Remarks

Refused at 3.00m bgl on assumed cobbles.

APPENDIX V
CHEMICAL TESTING RESULTS



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Analytical Report Number : 18-82954

Project / Site name:	Chipping	**Samples received on:**	20/04/2018
Your job number:	12-424	**Samples instructed on:**	20/04/2018
Your order number:	12424-8538-SM	**Analysis completed by:**	27/04/2018
Report Issue Number:	1	**Report issued on:**	27/04/2018
Samples Analysed:	11 soil samples		

Signed:

Jordan Hill
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Analytical Report Number: 18-82954

Project / Site name: Chipping
Your Order No: 12424-8538-SM

Lab Sample Number				947389	947390	947391	947392	947393
Sample Reference				TP101	TP101	TP103	TP104	TP104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	2.00	0.40	0.20	2.50
Date Sampled				18/04/2018	18/04/2018	18/04/2018	18/04/2018	18/04/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	13	11	16	20	10
Total mass of sample received	kg	0.001	NONE	0.48	0.45	0.40	0.42	0.44
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	Not-detected	Not-detected	-
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.9	8.0	7.4	6.9	8.0
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total Sulphate as SO_4	mg/kg	50	MCERTS	610	1300	370	960	1300
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	39	230	12	25	580
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.019	0.12	0.0061	0.013	0.29
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	19.3	116	6.1	12.6	289
Sulphide	mg/kg	1	MCERTS	< 1.0	1.6	< 1.0	< 1.0	66
Total Sulphur	mg/kg	50	MCERTS	890	2900	160	470	11000
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	1.3	-	-	-
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	0.32	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	0.97	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	0.85	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	0.62	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	0.42	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	0.63	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	0.24	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	0.45	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	0.22	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	0.21	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	-	4.93	< 0.80

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Environmental Science

Analytical Report Number: 18-82954

Project / Site name: Chipping
Your Order No: 12424-8538-SM

Lab Sample Number				947389	947390	947391	947392	947393
Sample Reference				TP101	TP101	TP103	TP104	TP104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	2.00	0.40	0.20	2.50
Date Sampled				18/04/2018	18/04/2018	18/04/2018	18/04/2018	18/04/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	21	22	19	17	23
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	3.3	2.8	2.9	2.3	3.0
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	12	12	16	18	12
Copper (aqua regia extractable)	mg/kg	1	MCERTS	36	39	27	34	47
Lead (aqua regia extractable)	mg/kg	1	MCERTS	34	34	36	60	37
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	50	49	41	29	50
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	13	9.1	2.3	2.8	12
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	160	150	130	150	150
Petroleum Hydrocarbons								
TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	12	14	< 2.0	< 2.0	2.9
TPH (C12 - C16)	mg/kg	4	MCERTS	16	30	< 4.0	< 4.0	19
TPH (C16 - C21)	mg/kg	1	MCERTS	15	34	< 1.0	4.0	29
TPH (C21 - C35)	mg/kg	1	MCERTS	24	48	< 1.0	21	48

Analytical Report Number: 18-82954

Project / Site name: Chipping
Your Order No: 12424-8538-SM

Lab Sample Number				947389	947390	947391	947392	947393
Sample Reference				TP101	TP101	TP103	TP104	TP104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	2.00	0.40	0.20	2.50
Date Sampled				18/04/2018	18/04/2018	18/04/2018	18/04/2018	18/04/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
VOCs								
Chloromethane	µg/kg	1	ISO 17025	-	-	< 1.0	-	-
Chloroethane	µg/kg	1	NONE	-	-	< 1.0	-	-
Bromomethane	µg/kg	1	ISO 17025	-	-	< 1.0	-	-
Vinyl Chloride	µg/kg	1	NONE	-	-	< 1.0	-	-
Trichlorofluoromethane	µg/kg	1	NONE	-	-	< 1.0	-	-
1,1-Dichloroethene	µg/kg	1	NONE	-	-	< 1.0	-	-
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	-	-	< 1.0	-	-
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,1-Dichloroethane	µg/kg	1	MCERTS	-	-	< 1.0	-	-
2,2-Dichloropropane	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Trichloromethane	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,1,1-Trichloroethane	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,2-Dichloroethane	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,1-Dichloropropene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Trans-1,2-dichloroethene	µg/kg	1	NONE	-	-	< 1.0	-	-
Benzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Tetrachloromethane	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,2-Dichloropropane	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Trichloroethene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Dibromomethane	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Bromodichloromethane	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-	< 1.0	-	-
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-	< 1.0	-	-
Toluene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,1,2-Trichloroethane	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,3-Dichloropropane	µg/kg	1	ISO 17025	-	-	< 1.0	-	-
Dibromochloromethane	µg/kg	1	ISO 17025	-	-	< 1.0	-	-
Tetrachloroethene	µg/kg	1	NONE	-	-	< 1.0	-	-
1,2-Dibromoethane	µg/kg	1	ISO 17025	-	-	< 1.0	-	-
Chlorobenzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Ethylbenzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
p & m-Xylene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Styrene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Tribromomethane	µg/kg	1	NONE	-	-	< 1.0	-	-
o-Xylene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Isopropylbenzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Bromobenzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
n-Propylbenzene	µg/kg	1	ISO 17025	-	-	< 1.0	-	-
2-Chlorotoluene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
4-Chlorotoluene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	-	-	< 1.0	-	-
tert-Butylbenzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	-	-	< 1.0	-	-
sec-Butylbenzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	-	-	< 1.0	-	-
p-Isopropyltoluene	µg/kg	1	ISO 17025	-	-	< 1.0	-	-
1,2-Dichlorobenzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,4-Dichlorobenzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Butylbenzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	-	-	< 1.0	-	-
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Hexachlorobutadiene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	-	-	< 1.0	-	-

Analytical Report Number: 18-82954

Project / Site name: Chipping
Your Order No: 12424-8538-SM

Lab Sample Number				947389	947390	947391	947392	947393
Sample Reference				TP101	TP101	TP103	TP104	TP104
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	2.00	0.40	0.20	2.50
Date Sampled				18/04/2018	18/04/2018	18/04/2018	18/04/2018	18/04/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
SVOCs								
Aniline	mg/kg	0.1	NONE	-	-	< 0.1	-	-
Phenol	mg/kg	0.2	ISO 17025	-	-	< 0.2	-	-
2-Chlorophenol	mg/kg	0.1	MCERTS	-	-	< 0.1	-	-
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	-	-	< 0.2	-	-
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	< 0.2	-	-
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	-	-	< 0.1	-	-
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	< 0.2	-	-
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	-	-	< 0.1	-	-
2-Methylphenol	mg/kg	0.3	MCERTS	-	-	< 0.3	-	-
Hexachloroethane	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Nitrobenzene	mg/kg	0.3	MCERTS	-	-	< 0.3	-	-
4-Methylphenol	mg/kg	0.2	NONE	-	-	< 0.2	-	-
Isophorone	mg/kg	0.2	MCERTS	-	-	< 0.2	-	-
2-Nitrophenol	mg/kg	0.3	MCERTS	-	-	< 0.3	-	-
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	-	-	< 0.3	-	-
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	-	-	< 0.3	-	-
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	-	-	< 0.3	-	-
Naphthalene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	-	-	< 0.3	-	-
4-Chloroaniline	mg/kg	0.1	NONE	-	-	< 0.1	-	-
Hexachlorobutadiene	mg/kg	0.1	MCERTS	-	-	< 0.1	-	-
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	-	-	< 0.1	-	-
2,4,6-Trichlorophenol	mg/kg	0.1	MCERTS	-	-	< 0.1	-	-
2,4,5-Trichlorophenol	mg/kg	0.2	MCERTS	-	-	< 0.2	-	-
2-Methylnaphthalene	mg/kg	0.1	NONE	-	-	< 0.1	-	-
2-Chloronaphthalene	mg/kg	0.1	MCERTS	-	-	< 0.1	-	-
Dimethylphthalate	mg/kg	0.1	MCERTS	-	-	< 0.1	-	-
2,6-Dinitrotoluene	mg/kg	0.1	MCERTS	-	-	< 0.1	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
2,4-Dinitrotoluene	mg/kg	0.2	MCERTS	-	-	< 0.2	-	-
Dibenzofuran	mg/kg	0.2	MCERTS	-	-	< 0.2	-	-
4-Chlorophenyl phenyl ether	mg/kg	0.3	ISO 17025	-	-	< 0.3	-	-
Diethyl phthalate	mg/kg	0.2	MCERTS	-	-	< 0.2	-	-
4-Nitroaniline	mg/kg	0.2	MCERTS	-	-	< 0.2	-	-
Fluorene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Azobenzene	mg/kg	0.3	MCERTS	-	-	< 0.3	-	-
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	-	-	< 0.2	-	-
Hexachlorobenzene	mg/kg	0.3	MCERTS	-	-	< 0.3	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Anthracene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Carbazole	mg/kg	0.3	MCERTS	-	-	< 0.3	-	-
Dibutyl phthalate	mg/kg	0.2	MCERTS	-	-	< 0.2	-	-
Anthraquinone	mg/kg	0.3	MCERTS	-	-	< 0.3	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Pyrene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Butyl benzyl phthalate	mg/kg	0.3	ISO 17025	-	-	< 0.3	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-

Analytical Report Number: 18-82954

Project / Site name: Chipping
Your Order No: 12424-8538-SM

Lab Sample Number				947394	947395	947396	947397	947398
Sample Reference				TP107	TP108	WS101B	WS101B	WS103A
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	2.00	0.40	1.20	0.80
Date Sampled				18/04/2018	18/04/2018	18/04/2018	18/04/2018	18/04/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	18	12	19	12	14
Total mass of sample received	kg	0.001	NONE	0.40	0.53	0.48	0.54	0.46
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	Not-detected	-	Not-detected
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.6	-	7.1	8.2	7.1
Total Cyanide	mg/kg	1	MCERTS	< 1	-	< 1	< 1	< 1
Total Sulphate as SO_4	mg/kg	50	MCERTS	690	-	180	450	260
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	18	-	30	50	40
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0092	-	0.015	0.025	0.020
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	9.2	-	15.0	25.0	19.8
Sulphide	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
Total Sulphur	mg/kg	50	MCERTS	300	-	110	530	130
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	0.9	-	-	-
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	< 0.05	< 0.05	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	-	< 0.80	< 0.80	< 0.80

Analytical Report Number: 18-82954

Project / Site name: Chipping
Your Order No: 12424-8538-SM

Lab Sample Number				947394	947395	947396	947397	947398
Sample Reference				TP107	TP108	WS101B	WS101B	WS103A
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	2.00	0.40	1.20	0.80
Date Sampled				18/04/2018	18/04/2018	18/04/2018	18/04/2018	18/04/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	16	-	20	22	20
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	1.1	-	0.5	2.9	2.5
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	-	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	16	-	17	15	14
Copper (aqua regia extractable)	mg/kg	1	MCERTS	26	-	24	42	35
Lead (aqua regia extractable)	mg/kg	1	MCERTS	56	-	30	36	38
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	-	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	20	-	21	52	50
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	1.8	-	1.9	5.8	2.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	88	-	60	140	140
Petroleum Hydrocarbons								
TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	-	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	-	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	-	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	-	< 2.0	2.8	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	-	< 4.0	7.5	< 4.0
TPH (C16 - C21)	mg/kg	1	MCERTS	< 1.0	-	< 1.0	9.4	< 1.0
TPH (C21 - C35)	mg/kg	1	MCERTS	< 1.0	-	< 1.0	19	< 1.0

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Project / Site name: Chipping
Your Order No: 12424-8538-SM

Lab Sample Number				947394	947395	947396	947397	947398
Sample Reference				TP107	TP108	WS101B	WS101B	WS103A
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	2.00	0.40	1.20	0.80
Date Sampled				18/04/2018	18/04/2018	18/04/2018	18/04/2018	18/04/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
VOCs								
Chloromethane	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Chloroethane	µg/kg	1	NONE	< 1.0	-	-	-	-
Bromomethane	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Vinyl Chloride	µg/kg	1	NONE	< 1.0	-	-	-	-
Trichlorofluoromethane	µg/kg	1	NONE	< 1.0	-	-	-	-
1,1-Dichloroethene	µg/kg	1	NONE	< 1.0	-	-	-	-
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,1-Dichloroethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
2,2-Dichloropropane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Trichloromethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,1,1-Trichloroethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,2-Dichloroethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,1-Dichloropropene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Trans-1,2-dichloroethene	µg/kg	1	NONE	< 1.0	-	-	-	-
Benzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Tetrachloromethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,2-Dichloropropane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Trichloroethene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Dibromomethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Bromodichloromethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Toluene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,1,2-Trichloroethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,3-Dichloropropane	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Dibromochloromethane	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Tetrachloroethene	µg/kg	1	NONE	< 1.0	-	-	-	-
1,2-Dibromoethane	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
Chlorobenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
p & m-Xylene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Styrene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Tribromomethane	µg/kg	1	NONE	< 1.0	-	-	-	-
o-Xylene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Isopropylbenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Bromobenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
n-Propylbenzene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
2-Chlorotoluene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
4-Chlorotoluene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
tert-Butylbenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
sec-Butylbenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
p-Isopropyltoluene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
1,2-Dichlorobenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,4-Dichlorobenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Butylbenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	< 1.0	-	-	-	-
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
Hexachlorobutadiene	µg/kg	1	MCERTS	< 1.0	-	-	-	-
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	< 1.0	-	-	-	-

Analytical Report Number: 18-82954

Project / Site name: Chipping
Your Order No: 12424-8538-SM

Lab Sample Number				947394	947395	947396	947397	947398
Sample Reference				TP107	TP108	WS101B	WS101B	WS103A
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20	2.00	0.40	1.20	0.80
Date Sampled				18/04/2018	18/04/2018	18/04/2018	18/04/2018	18/04/2018
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
SVOCs								
Aniline	mg/kg	0.1	NONE	< 0.1	-	-	-	-
Phenol	mg/kg	0.2	ISO 17025	< 0.2	-	-	-	-
2-Chlorophenol	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
2-Methylphenol	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
Hexachloroethane	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Nitrobenzene	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
4-Methylphenol	mg/kg	0.2	NONE	< 0.2	-	-	-	-
Isophorone	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
2-Nitrophenol	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
4-Chloroaniline	mg/kg	0.1	NONE	< 0.1	-	-	-	-
Hexachlorobutadiene	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	< 0.1	-	-	-	-
2,4,6-Trichlorophenol	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
2,4,5-Trichlorophenol	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
2-Methylnaphthalene	mg/kg	0.1	NONE	< 0.1	-	-	-	-
2-Chloronaphthalene	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
Dimethylphthalate	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
2,6-Dinitrotoluene	mg/kg	0.1	MCERTS	< 0.1	-	-	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
2,4-Dinitrotoluene	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
Dibenzofuran	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
4-Chlorophenyl phenyl ether	mg/kg	0.3	ISO 17025	< 0.3	-	-	-	-
Diethyl phthalate	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
4-Nitroaniline	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
Fluorene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Azobenzene	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
Hexachlorobenzene	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Anthracene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Carbazole	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
Dibutyl phthalate	mg/kg	0.2	MCERTS	< 0.2	-	-	-	-
Anthraquinone	mg/kg	0.3	MCERTS	< 0.3	-	-	-	-
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Pyrene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Butyl benzyl phthalate	mg/kg	0.3	ISO 17025	< 0.3	-	-	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Chrysene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	-	-	-	-

Analytical Report Number: 18-82954

Project / Site name: Chipping
Your Order No: 12424-8538-SM

Lab Sample Number				947399				
Sample Reference				WS103B				
Sample Number				None Supplied				
Depth (m)				1.80				
Date Sampled				18/04/2018				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1				
Moisture Content	%	N/A	NONE	6.5				
Total mass of sample received	kg	0.001	NONE	0.40				
Asbestos in Soil	Type	N/A	ISO 17025	-				
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	6.9				
Total Cyanide	mg/kg	1	MCERTS	< 1				
Total Sulphate as SO_4	mg/kg	50	MCERTS	1300				
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	680				
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.34				
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	341				
Sulphide	mg/kg	1	MCERTS	44				
Total Sulphur	mg/kg	50	MCERTS	14000				
Total Organic Carbon (TOC)	%	0.1	MCERTS	1.6				
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0				
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05				
Fluorene	mg/kg	0.05	MCERTS	< 0.05				
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05				
Anthracene	mg/kg	0.05	MCERTS	< 0.05				
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Pyrene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05				
Chrysene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05				
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05				
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05				
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80				

Analytical Report Number: 18-82954

Project / Site name: Chipping
Your Order No: 12424-8538-SM

Lab Sample Number				947399				
Sample Reference				WS103B				
Sample Number				None Supplied				
Depth (m)				1.80				
Date Sampled				18/04/2018				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	18				
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	2.3				
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0				
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	11				
Copper (aqua regia extractable)	mg/kg	1	MCERTS	35				
Lead (aqua regia extractable)	mg/kg	1	MCERTS	30				
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3				
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	43				
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	9.0				
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	110				
Petroleum Hydrocarbons								
TPH (C5 - C6)	mg/kg	1	NONE	< 1.0				
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1				
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1				
TPH (C10 - C12)	mg/kg	2	MCERTS	3.4				
TPH (C12 - C16)	mg/kg	4	MCERTS	15				
TPH (C16 - C21)	mg/kg	1	MCERTS	19				
TPH (C21 - C35)	mg/kg	1	MCERTS	34				

Analytical Report Number: 18-82954

Project / Site name: Chipping
Your Order No: 12424-8538-SM

Lab Sample Number				947399				
Sample Reference				WS103B				
Sample Number				None Supplied				
Depth (m)				1.80				
Date Sampled				18/04/2018				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
VOCs								
Chloromethane	µg/kg	1	ISO 17025	-				
Chloroethane	µg/kg	1	NONE	-				
Bromomethane	µg/kg	1	ISO 17025	-				
Vinyl Chloride	µg/kg	1	NONE	-				
Trichlorofluoromethane	µg/kg	1	NONE	-				
1,1-Dichloroethene	µg/kg	1	NONE	-				
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	-				
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	-				
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-				
1,1-Dichloroethane	µg/kg	1	MCERTS	-				
2,2-Dichloropropane	µg/kg	1	MCERTS	-				
Trichloromethane	µg/kg	1	MCERTS	-				
1,1,1-Trichloroethane	µg/kg	1	MCERTS	-				
1,2-Dichloroethane	µg/kg	1	MCERTS	-				
1,1-Dichloropropene	µg/kg	1	MCERTS	-				
Trans-1,2-dichloroethene	µg/kg	1	NONE	-				
Benzene	µg/kg	1	MCERTS	-				
Tetrachloromethane	µg/kg	1	MCERTS	-				
1,2-Dichloropropane	µg/kg	1	MCERTS	-				
Trichloroethene	µg/kg	1	MCERTS	-				
Dibromomethane	µg/kg	1	MCERTS	-				
Bromodichloromethane	µg/kg	1	MCERTS	-				
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	-				
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	-				
Toluene	µg/kg	1	MCERTS	-				
1,1,2-Trichloroethane	µg/kg	1	MCERTS	-				
1,3-Dichloropropane	µg/kg	1	ISO 17025	-				
Dibromochloromethane	µg/kg	1	ISO 17025	-				
Tetrachloroethene	µg/kg	1	NONE	-				
1,2-Dibromoethane	µg/kg	1	ISO 17025	-				
Chlorobenzene	µg/kg	1	MCERTS	-				
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	-				
Ethylbenzene	µg/kg	1	MCERTS	-				
p & m-Xylene	µg/kg	1	MCERTS	-				
Styrene	µg/kg	1	MCERTS	-				
Tribromomethane	µg/kg	1	NONE	-				
o-Xylene	µg/kg	1	MCERTS	-				
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	-				
Isopropylbenzene	µg/kg	1	MCERTS	-				
Bromobenzene	µg/kg	1	MCERTS	-				
n-Propylbenzene	µg/kg	1	ISO 17025	-				
2-Chlorotoluene	µg/kg	1	MCERTS	-				
4-Chlorotoluene	µg/kg	1	MCERTS	-				
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	-				
tert-Butylbenzene	µg/kg	1	MCERTS	-				
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	-				
sec-Butylbenzene	µg/kg	1	MCERTS	-				
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	-				
p-Isopropyltoluene	µg/kg	1	ISO 17025	-				
1,2-Dichlorobenzene	µg/kg	1	MCERTS	-				
1,4-Dichlorobenzene	µg/kg	1	MCERTS	-				
Butylbenzene	µg/kg	1	MCERTS	-				
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	-				
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	-				
Hexachlorobutadiene	µg/kg	1	MCERTS	-				
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	-				

Analytical Report Number: 18-82954

Project / Site name: Chipping
Your Order No: 12424-8538-SM

Lab Sample Number				947399				
Sample Reference				WS103B				
Sample Number				None Supplied				
Depth (m)				1.80				
Date Sampled				18/04/2018				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
SVOCs								
Aniline	mg/kg	0.1	NONE	-				
Phenol	mg/kg	0.2	ISO 17025	-				
2-Chlorophenol	mg/kg	0.1	MCERTS	-				
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	-				
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	-				
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	-				
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	-				
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	-				
2-Methylphenol	mg/kg	0.3	MCERTS	-				
Hexachloroethane	mg/kg	0.05	MCERTS	-				
Nitrobenzene	mg/kg	0.3	MCERTS	-				
4-Methylphenol	mg/kg	0.2	NONE	-				
Isophorone	mg/kg	0.2	MCERTS	-				
2-Nitrophenol	mg/kg	0.3	MCERTS	-				
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	-				
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	-				
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	-				
Naphthalene	mg/kg	0.05	MCERTS	-				
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	-				
4-Chloroaniline	mg/kg	0.1	NONE	-				
Hexachlorobutadiene	mg/kg	0.1	MCERTS	-				
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	-				
2,4,6-Trichlorophenol	mg/kg	0.1	MCERTS	-				
2,4,5-Trichlorophenol	mg/kg	0.2	MCERTS	-				
2-Methylnaphthalene	mg/kg	0.1	NONE	-				
2-Chloronaphthalene	mg/kg	0.1	MCERTS	-				
Dimethylphthalate	mg/kg	0.1	MCERTS	-				
2,6-Dinitrotoluene	mg/kg	0.1	MCERTS	-				
Acenaphthylene	mg/kg	0.05	MCERTS	-				
Acenaphthene	mg/kg	0.05	MCERTS	-				
2,4-Dinitrotoluene	mg/kg	0.2	MCERTS	-				
Dibenzofuran	mg/kg	0.2	MCERTS	-				
4-Chlorophenyl phenyl ether	mg/kg	0.3	ISO 17025	-				
Diethyl phthalate	mg/kg	0.2	MCERTS	-				
4-Nitroaniline	mg/kg	0.2	MCERTS	-				
Fluorene	mg/kg	0.05	MCERTS	-				
Azobenzene	mg/kg	0.3	MCERTS	-				
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	-				
Hexachlorobenzene	mg/kg	0.3	MCERTS	-				
Phenanthrene	mg/kg	0.05	MCERTS	-				
Anthracene	mg/kg	0.05	MCERTS	-				
Carbazole	mg/kg	0.3	MCERTS	-				
Dibutyl phthalate	mg/kg	0.2	MCERTS	-				
Anthraquinone	mg/kg	0.3	MCERTS	-				
Fluoranthene	mg/kg	0.05	MCERTS	-				
Pyrene	mg/kg	0.05	MCERTS	-				
Butyl benzyl phthalate	mg/kg	0.3	ISO 17025	-				
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-				
Chrysene	mg/kg	0.05	MCERTS	-				
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-				
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-				
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-				
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-				
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-				
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-				

Analytical Report Number : 18-82954

Project / Site name: Chipping

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
947389	TP101	None Supplied	0.30	Brown loam and clay with gravel.
947390	TP101	None Supplied	2.00	Brown loam and clay with gravel.
947391	TP103	None Supplied	0.40	Brown loam and clay with gravel.
947392	TP104	None Supplied	0.20	Brown loam and clay with gravel and vegetation.
947393	TP104	None Supplied	2.50	Brown clay and sand with gravel.
947394	TP107	None Supplied	0.20	Brown loam and sand with gravel and vegetation.
947395	TP108	None Supplied	2.00	Brown sandy clay.
947396	WS101B	None Supplied	0.40	Light brown clay and sand with gravel.
947397	WS101B	None Supplied	1.20	Brown clay and sand.
947398	WS103A	None Supplied	0.80	Brown clay and sand.
947399	WS103B	None Supplied	1.80	Brown clay and sand with gravel.

Analytical Report Number : 18-82954

Project / Site name: Chipping

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds in soil by extraction in dichloromethane and hexane followed by GC-MS.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L009-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, and MEWAM 2006 Methods for the Determination of Metals in Soil	L038-PL	D	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L076-PL	D	NONE

Analytical Report Number : 18-82954

Project / Site name: Chipping

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

4041

Environmental Science

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Analytical Report Number : 18-86410

Project / Site name:	Chipping	**Samples received on:**	20/04/2018
Your job number:	12-424	**Samples instructed on:**	23/05/2018
Your order number:	12424-8538-SM	**Analysis completed by:**	29/05/2018
Report Issue Number:	1	**Report issued on:**	29/05/2018
Samples Analysed:	2 leachate samples		

Signed:

Jordan Hill
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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UKAS TESTING 4041

Analytical i2 Environmental Science

Analytical Report Number: 18-86410

Project / Site name: Chipping

Your Order No: 12424-8538-SM

Lab Sample Number				966132	966133			
Sample Reference				TP102	WS101A			
Sample Number				None Supplied	None Supplied			
Depth (m)				2.80	0.50			
Date Sampled				18/04/2018	18/04/2018			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
General Inorganics								
pH	pH Units	N/A	ISO 17025	7.4	7.1			
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0	< 1.0			
Total Phenols								
Total Phenols (monohydric)	µg/l	1	ISO 17025	3.6	3.9			
Speciated PAHs								
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Indeno(1,2,3-cd)pyrene	µg/l	0.01	NONE	< 0.01	< 0.01			
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01	< 0.01			
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01	< 0.01			
Total PAH								
Total EPA-16 PAHs	µg/l	0.2	NONE	< 0.2	< 0.2			
Heavy Metals / Metalloids								
Arsenic (dissolved)	µg/l	1.1	ISO 17025	1.7	< 1.1			
Cadmium (dissolved)	µg/l	0.08	ISO 17025	0.56	< 0.08			
Chromium (hexavalent)	µg/l	5	NONE	< 5.0	< 5.0			
Chromium (dissolved)	µg/l	0.4	ISO 17025	< 0.4	< 0.4			
Copper (dissolved)	µg/l	0.7	ISO 17025	16	3.1			
Lead (dissolved)	µg/l	1	ISO 17025	2.2	< 1.0			
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	< 0.5			
Nickel (dissolved)	µg/l	0.3	ISO 17025	4.7	< 0.3			
Selenium (dissolved)	µg/l	4	ISO 17025	150	< 4.0			
Zinc (dissolved)	µg/l	0.4	ISO 17025	11	2.6			

Analytical Report Number: 18-86410

Project / Site name: Chipping

Your Order No: 12424-8538-SM

Lab Sample Number				966132	966133			
Sample Reference				TP102	WS101A			
Sample Number				None Supplied	None Supplied			
Depth (m)				2.80	0.50			
Date Sampled				18/04/2018	18/04/2018			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status					
Monoaromatics								
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0			
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0			
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0			
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0			
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0			
MTBE (Methyl Tertiary Butyl Ether)	µg/l	10	NONE	< 10	< 10			
Petroleum Hydrocarbons								
TPH1 (C10 - C40)	µg/l	10	NONE	< 10	< 10			
TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0			
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0			
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0			
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10			
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10			
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10			
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10			
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10			
TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0			
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0			
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0			
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10			
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10			
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10			
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10			
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10			

UKAS TESTING 4041

Environmental Science

Analytical Report Number : 18-86410

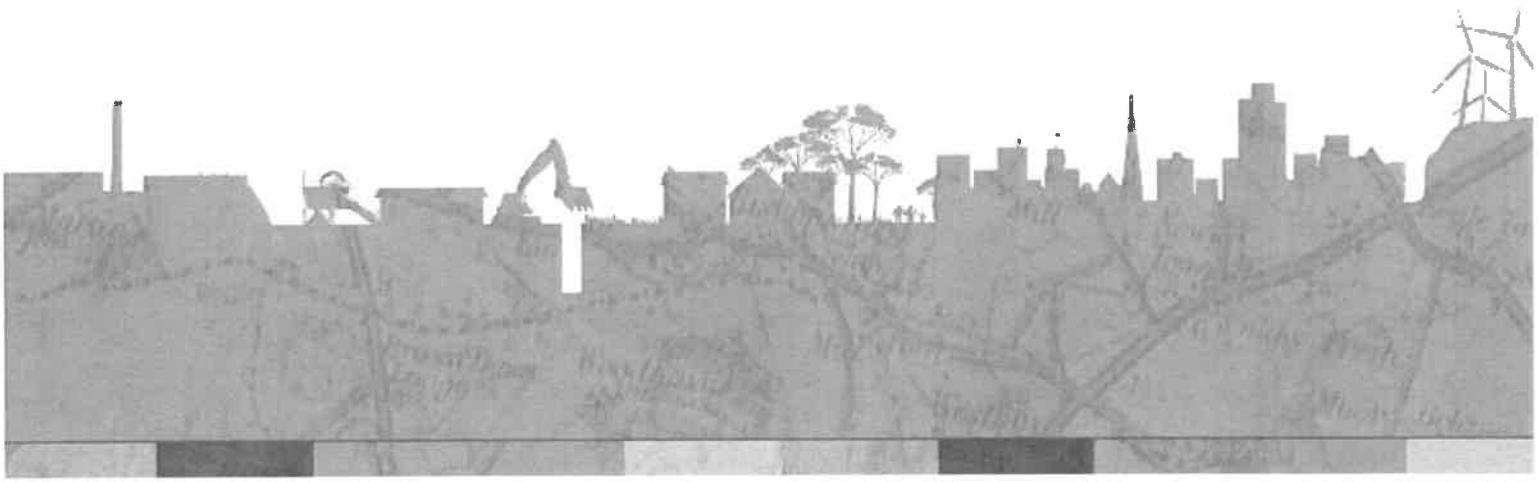
Project / Site name: Chipping

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
BS EN 12457-1 (2:1) Leachate Prep	2:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-1.	L043-PL	W	NONE
BTEX and MTBE in leachates (Monoaromatics)	Determination of BTEX and MTBE in leachates by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Hexavalent chromium in leachate	Determination of hexavalent chromium in leachate by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	NONE
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in leachate - LOW LEVEL 1 ug/l	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
pH at 20oC in leachate	Determination of pH in leachate by electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L005-PL	W	ISO 17025
Speciated EPA-16 PAHs in leachate	Determination of PAH compounds in leachate by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L102B-PL	W	NONE
Total cyanide in leachate - 1µg/l	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
TPH1 (Leachates)	Determination of dichloromethane extractable hydrocarbons in leachate by GC-MS.	In-house method	L070-PL	W	NONE

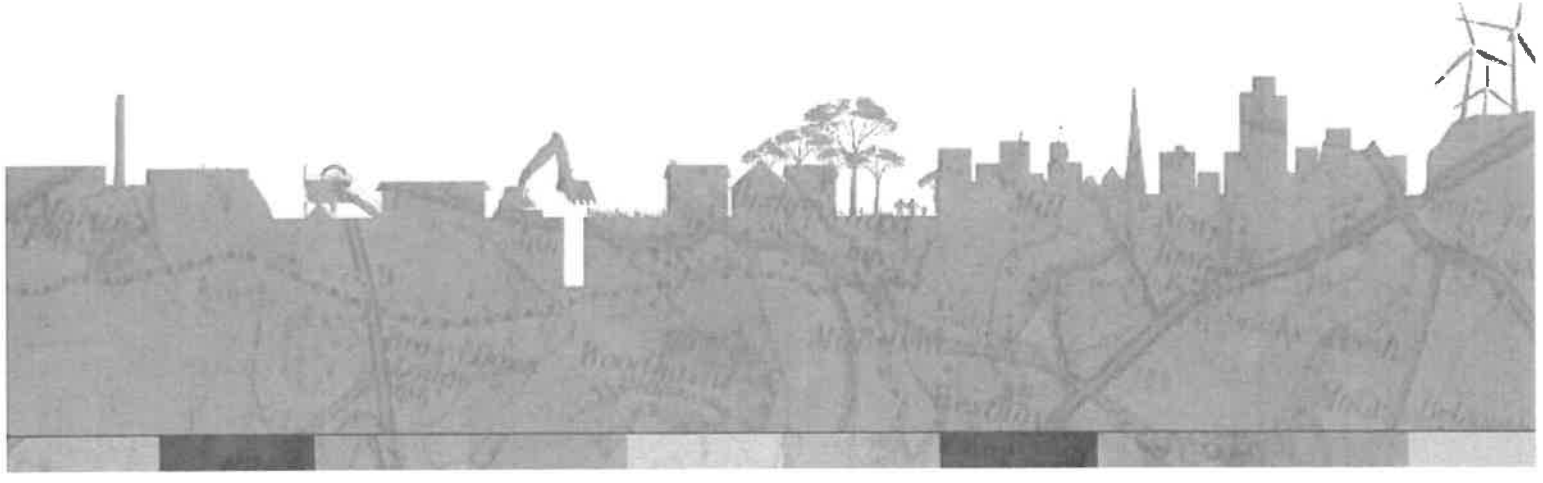
For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

APPENDIX VI
ORIGIN OF TIER I GENERIC ASSESSMENT CRITERIA



Constituent	Origin of Risk Assessment Value
Arsenic	2014 LQM/CIEH S4ULs
Cadmium	2014 LQM/CIEH S4ULs
Chromium	2014 LQM/CIEH S4ULs
Lead	2014 LQM/CIEH S4ULs
Mercury	2014 LQM/CIEH S4ULs - methylmercury
Nickel	2014 LQM/CIEH S4ULs
Selenium	2014 LQM/CIEH S4ULs
Copper	2014 LQM/CIEH S4ULs
Zinc	2014 LQM/CIEH S4ULs
Cyanide - Total	2014 LQM/CIEH S4ULs
Phenols - Total.	2014 LQM/CIEH S4ULs
Naphthalene	General Assessment Criteria (GAC) developed by CIEH / LQM Suitable 4 Use Levels with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM
Acenaphthylene	
Acenaphthene	
Fluorene	
Phenanthrene	
Anthracene	
Fluoranthene	
Pyrene	
Benzo(a)Anthracene[	
Chrysene	
Benzo(b/k)Fluoranthene [iii]	
Benzo(a)Pyrene	
Indeno(123-cd)Pyrene	
Dibenzo(a,h)Anthracene	
Benzo(ghi)Perylene	
TPH C_5-C_6 (aliphatic)	
TPH C_6-C_8 (aliphatic)	
TPH C_8-C_{10} (aliphatic)	
TPH C_{10}-C_{12} (aliphatic)	
TPH C_{12}-C_{16} (aromatic)	
TPH C_{16}-C_{21} (aromatic)	
TPH C_{21}-C_{35} (aromatic)	

APPENDIX VII
GEOTECHNICAL TESTING RESULTS



LABORATORY REPORT

REPORT

4043

Contract Number: PSL18/2107

Report Date: 01 June 2018

Client's Reference: 12424

Client Name: E3P
Heliport Business Park
Liverpool Road
Eccles
Manchester
M30 7RU

For the attention of: Roy Walker

Contract Title: Chipping

Date Received: 3/5/2018
Date Commenced: 3/5/2018
Date Completed: 1/6/2018

Notes: **Opinions and Interpretations are outside the UKAS Accreditation**

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson (Director)

A Watkins (Director)

R Berriman (Quality Manager)

L Knight (Senior Technician)

S Eyre (Senior Technician)

A Fry (Senior Technician)

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awatkins@prosoils.co.uk

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
TP101		Bulks	1.50		Dark brown very gravelly very sandy CLAY.
TP108		Bulks	3.00		Dark brown very gravelly very sandy CLAY.

UKAS TESTING 4043

PSL Professional Soils Laboratory

Chipping

Contract No:
PSL18/2107
Client Ref:
12424/8578/sm

PARTICLE SIZE DISTRIBUTION TEST

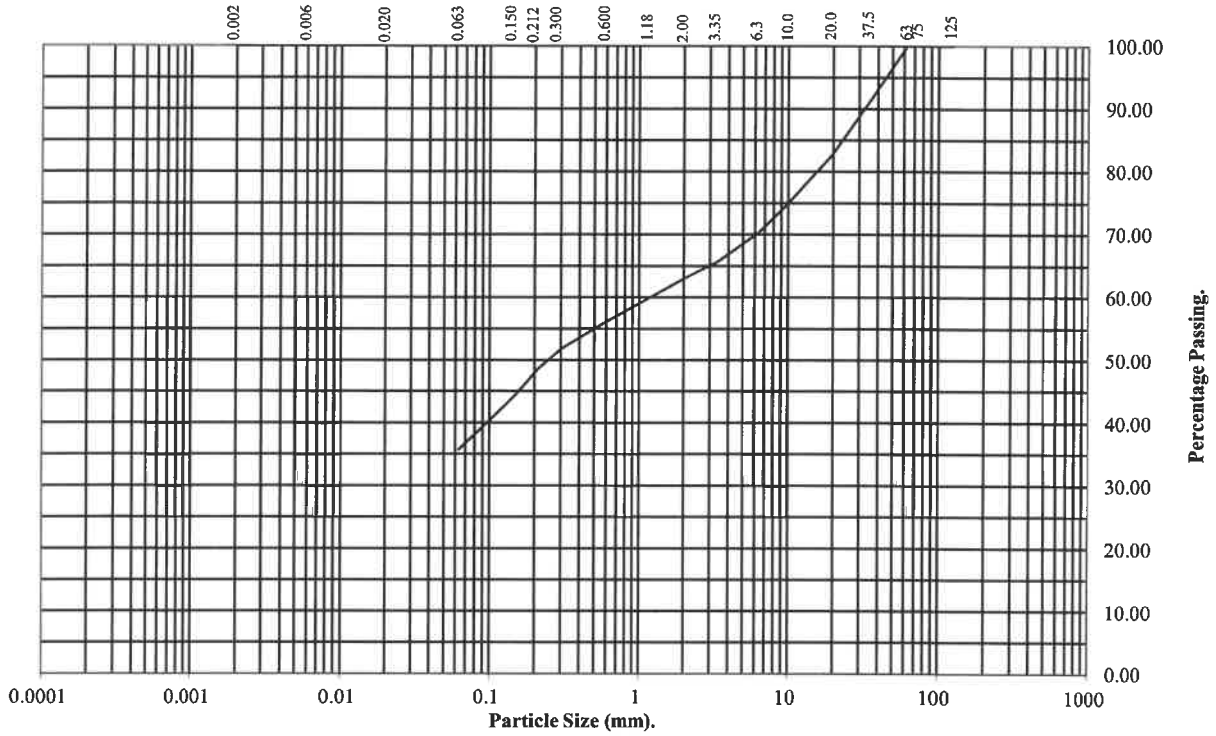
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: TP101 **Top Depth (m):** 1.50

Sample Number: **Base Depth(m):**

Sample Type: Bulks



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	92
20	83
10	75
6.3	70
3.35	66
2	63
1.18	60
0.6	56
0.3	52
0.212	49
0.15	44
0.063	36

Soil Fraction	Total Percentage
Cobbles	0
Gravel	37
Sand	27
Silt/Clay	36

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL Professional Soils Laboratory

Chipping

Contract No: PSL18/2107

Client Ref: 12424/8578/sm

PARTICLE SIZE DISTRIBUTION TEST

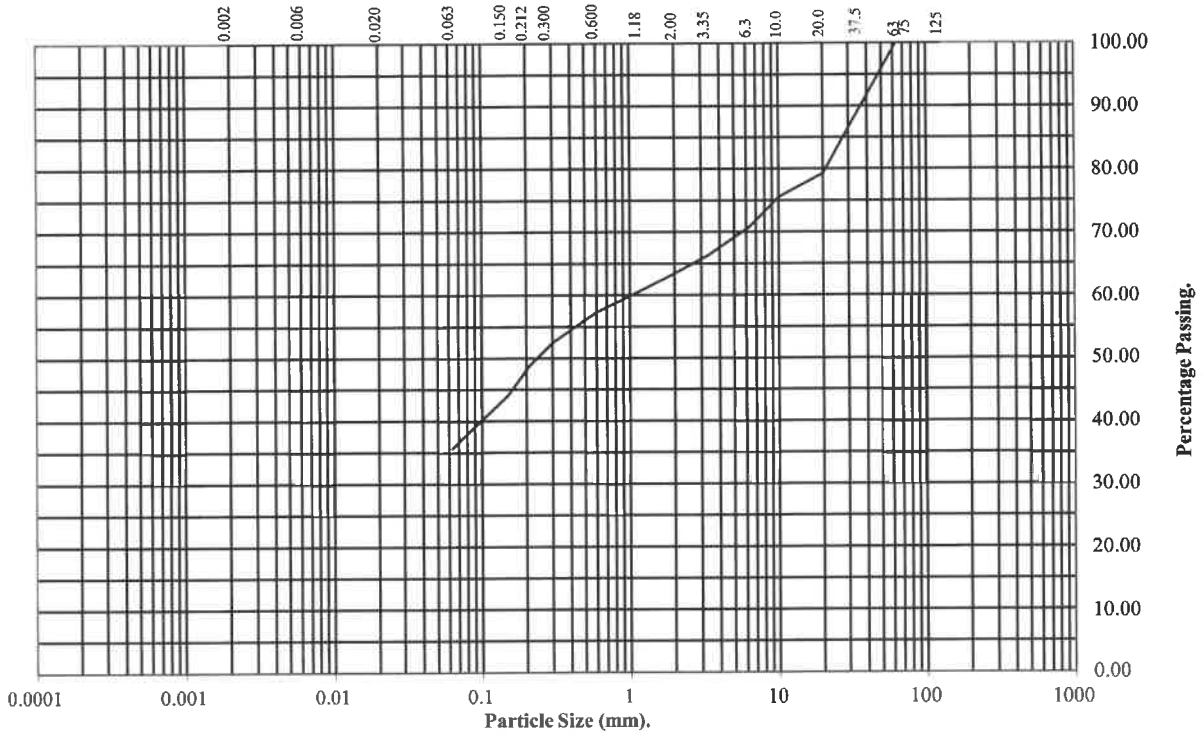
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: TP108 **Top Depth (m):** 3.00

Sample Number: **Base Depth(m):**

Sample Type: Bulks



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	91
20	79
10	76
6.3	71
3.35	66
2	63
1.18	61
0.6	57
0.3	52
0.212	49
0.15	44
0.063	36

Soil Fraction	Total Percentage
Cobbles	0
Gravel	37
Sand	27
Silt/Clay	36

Remarks:
See Summary of Soil Descriptions

UKAS TESTING 4043

PSL Professional Soils Laboratory

Chipping

Contract No: PSL18/2107

Client Ref: 12424/8578/sm

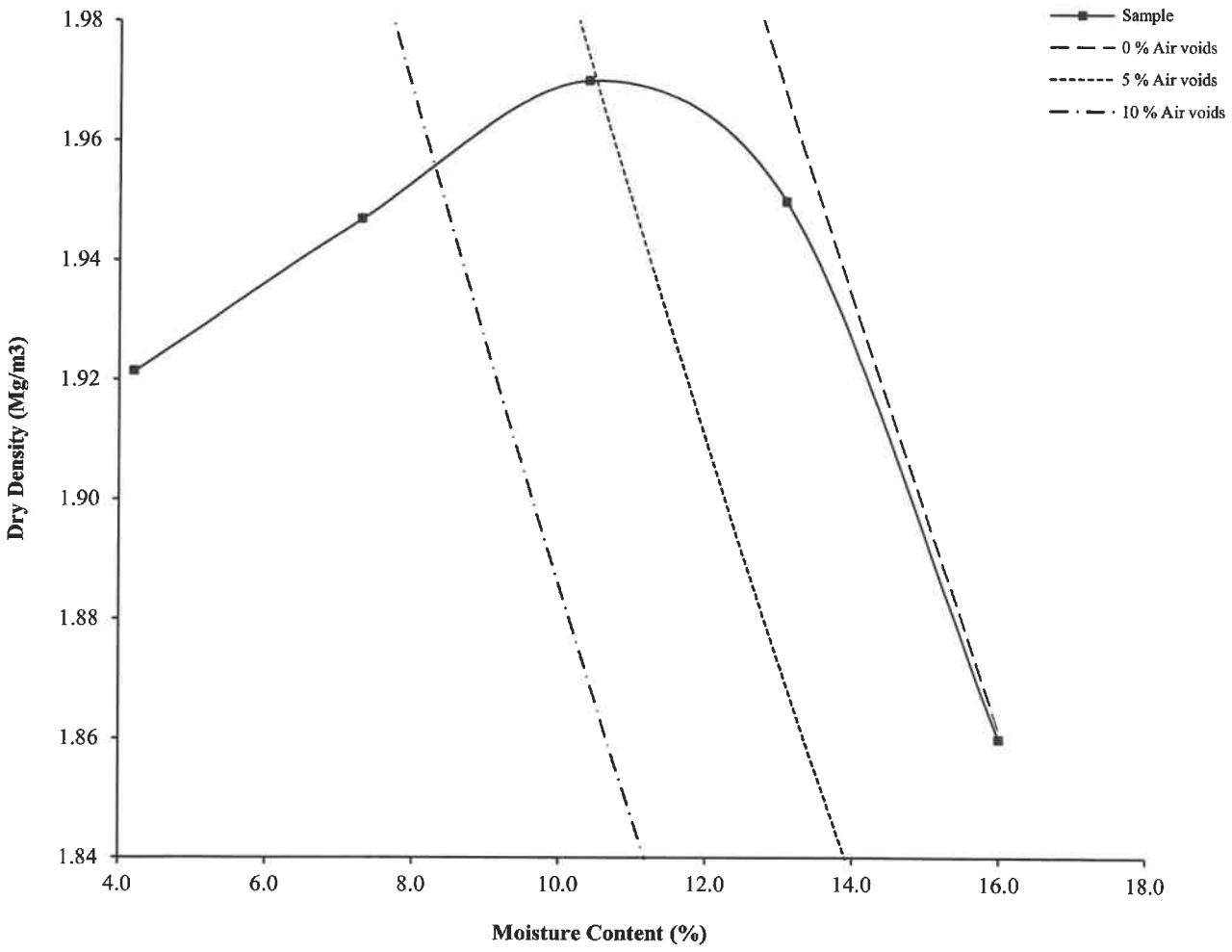
DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : 1990

Hole Number: TP101 **Top Depth (m) :** 1.50

Sample Number: **Base Depth (m) :**

Sample Type: Bulks



Initial Moisture Content:		10	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m3):	2.65	Assumed	Material Retained on 37.5 mm Test Sieve (%):		8
Maximum Dry Density (Mg/m3):		1.97	Material Retained on 20.0 mm Test Sieve (%):		9
Optimum Moisture Content (%):		10			
Remarks See summary of soil descriptions.					

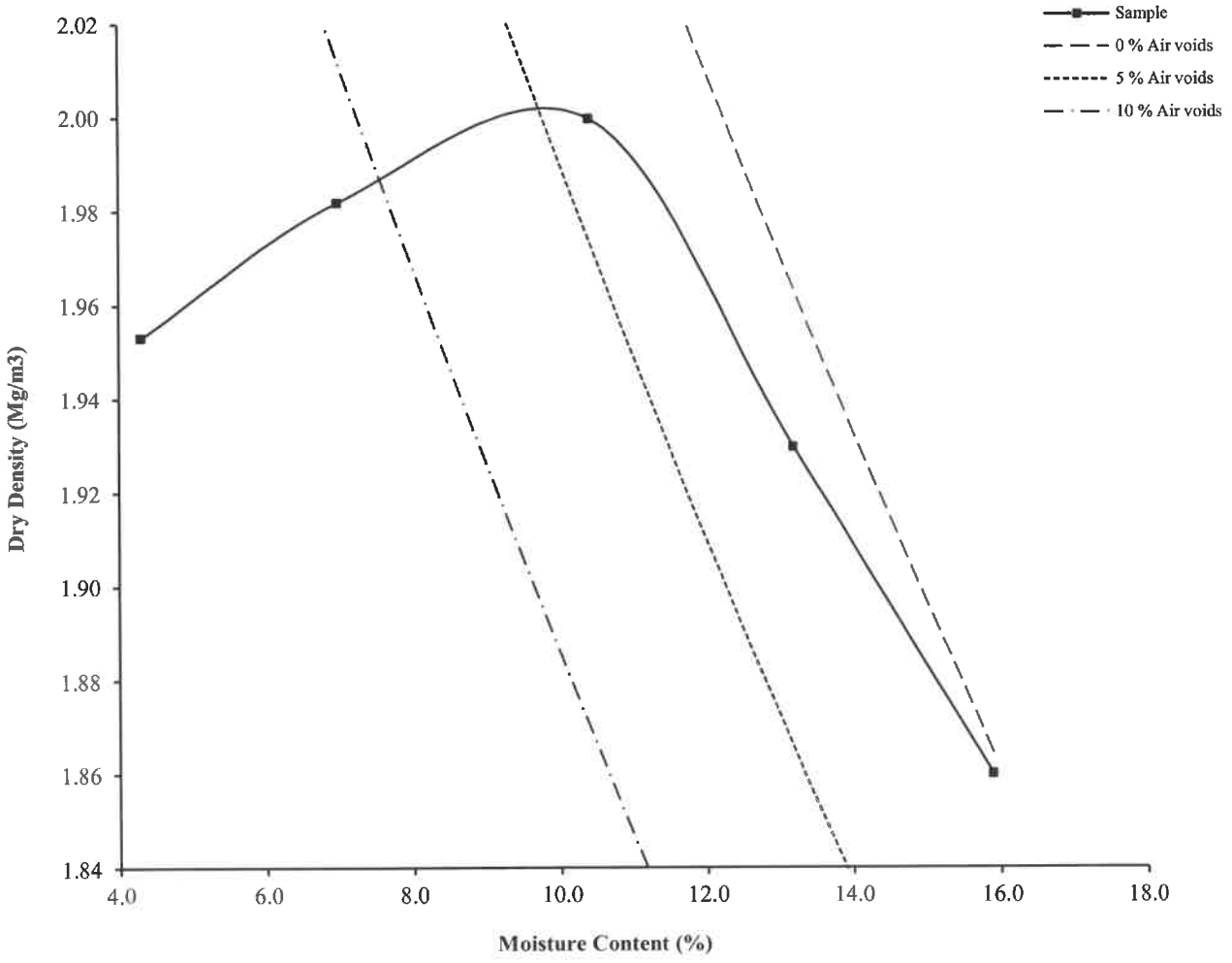
DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : 1990

Hole Number: TP108 **Top Depth (m) :** 3.00

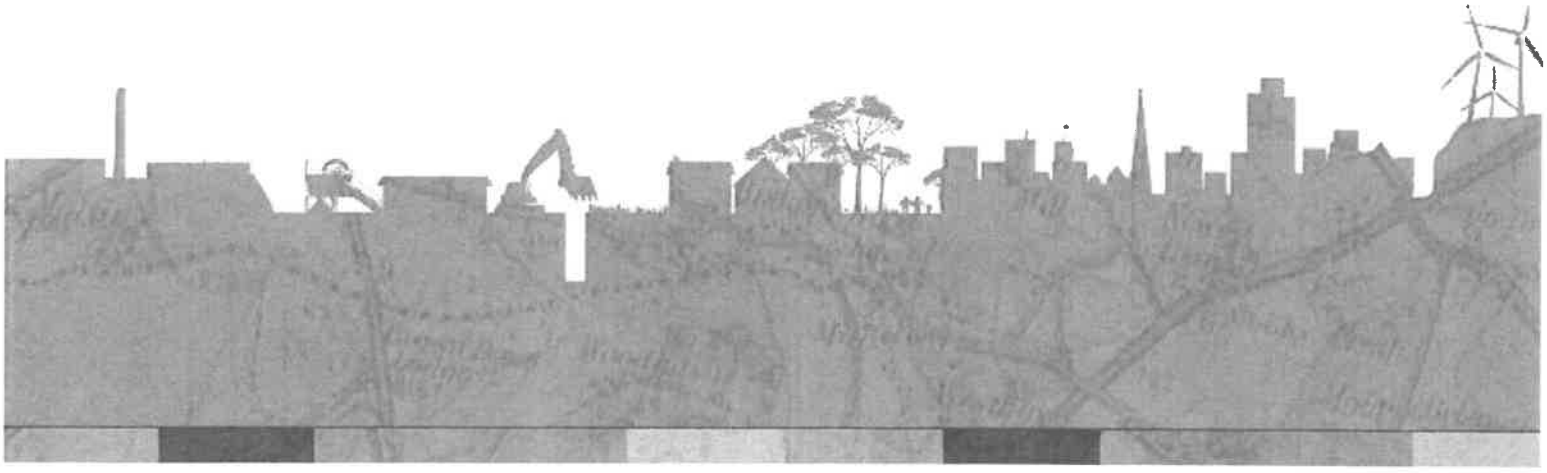
Sample Number: **Base Depth (m) :**

Sample Type: Bulks



Initial Moisture Content:		10	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m3):	2.65	Assumed	Material Retained on 37.5 mm Test Sieve (%):		9
Maximum Dry Density (Mg/m3):		2.00	Material Retained on 20.0 mm Test Sieve (%):		12
Optimum Moisture Content (%):		10			
Remarks See summary of soil descriptions.					

APPENDIX VIII
DYNAMIC CONE PENETROMETER TEST CERTIFICATES



Dynamic Probe Test Results Sheet

DP No: SHDP101

Site: **Chipping 4**

Job Number: **12-424**

Client: **Chadkirk Consulting**

Rig Type:

Date: 19th April 2018

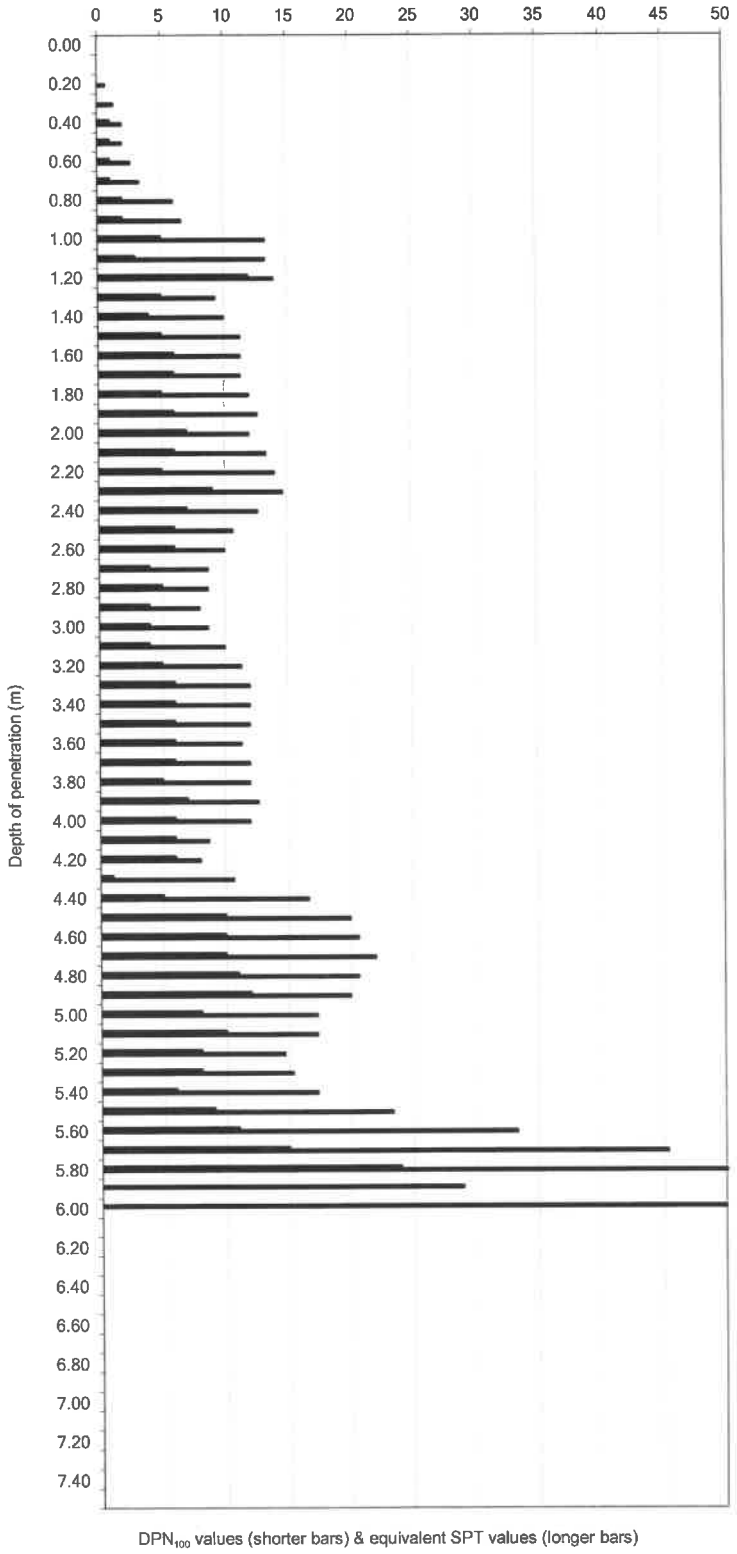
Test Type: SHDP

Final Depth: 6.0

Sheet 1 of 1

e3p

Penetration Test Results			
Depth (m)	DPN_{100}	DPN_{300}	SPT N *
0.00	0	0	0
0.10	0	0	0
0.20	0	1	1
0.30	0	2	1
0.40	1	3	2
0.50	1	3	2
0.60	1	4	3
0.70	1	5	3
0.80	2	9	6
0.90	2	10	7
1.00	5	20	13
1.10	3	20	13
1.20	12	21	14
1.30	5	14	9
1.40	4	15	10
1.50	5	17	11
1.60	6	17	11
1.70	6	17	11
1.80	5	18	12
1.90	6	19	13
2.00	7	18	12
2.10	6	20	13
2.20	5	21	14
2.30	9	22	15
2.40	7	19	13
2.50	6	16	11
2.60	6	15	10
2.70	4	13	9
2.80	5	13	9
2.90	4	12	8
3.00	4	13	9
3.10	4	15	10
3.20	5	17	11
3.30	6	18	12
3.40	6	18	12
3.50	6	18	12
3.60	6	17	11
3.70	6	18	12
3.80	5	18	12
3.90	7	19	13
4.00	6	18	12
4.10	6	13	9
4.20	6	12	8
4.30	1	16	11
4.40	5	25	17
4.50	10	30	20
4.60	10	31	21
4.70	10	33	22
4.80	11	31	21
4.90	12	30	20
5.00	8	26	17
5.10	10	26	17
5.20	8	22	15
5.30	8	23	15
5.40	6	26	17
5.50	9	35	23
5.60	11	50	33
5.70	15	68	45
5.80	24	103	69
5.90	29		
6.00	50		
6.10			
6.20			
6.30			
6.40			
6.50			
6.60			
6.70			
6.80			
6.90			
7.00			
7.10			
7.20			
7.30			
7.40			
7.50			



DPN_{100} values (shorter bars) & equivalent SPT values (longer bars)

Hammer Mass: 50 kg Cone Dia: 43.7mm

Drop Height: 500 mm Test by: RJW

General Remarks:

DPN_{100} = Dynamic penetration resistance for 100mm penetration.

DPN_{300} = Dynamic penetration resistance for 300mm penetration (ie: sum of 3 consecutive DPN_{100} values), starting at the depth given.

* Equivalent SPT N-values (for 300mm penetration) assumed to approximate the DPN_{300} values for dynamic probe "super-heavy" test (DPSH).

For dynamic probe "heavy" test (DPH), equivalent SPT N-values estimated using the theoretical relationship DPN_{300} = 1.5 SPT-N. [see Card,G.B., Roche,D.P. & Herbert,S.M., in Geol. Soc. Special Publication No 6, *Field Testing in Engineering Geology* (1990)]. SPT values are estimated and are for general guidance only.

Dynamic Probe Test Results Sheet

DP No: SHDP102

Site: **Collinwood Farm**

Job Number: **11-079**

Client: **Pringle Homes Ltd**

Rig Type:

Date: 6th April 2016

Test Type: SHDP

Final Depth: 5.0

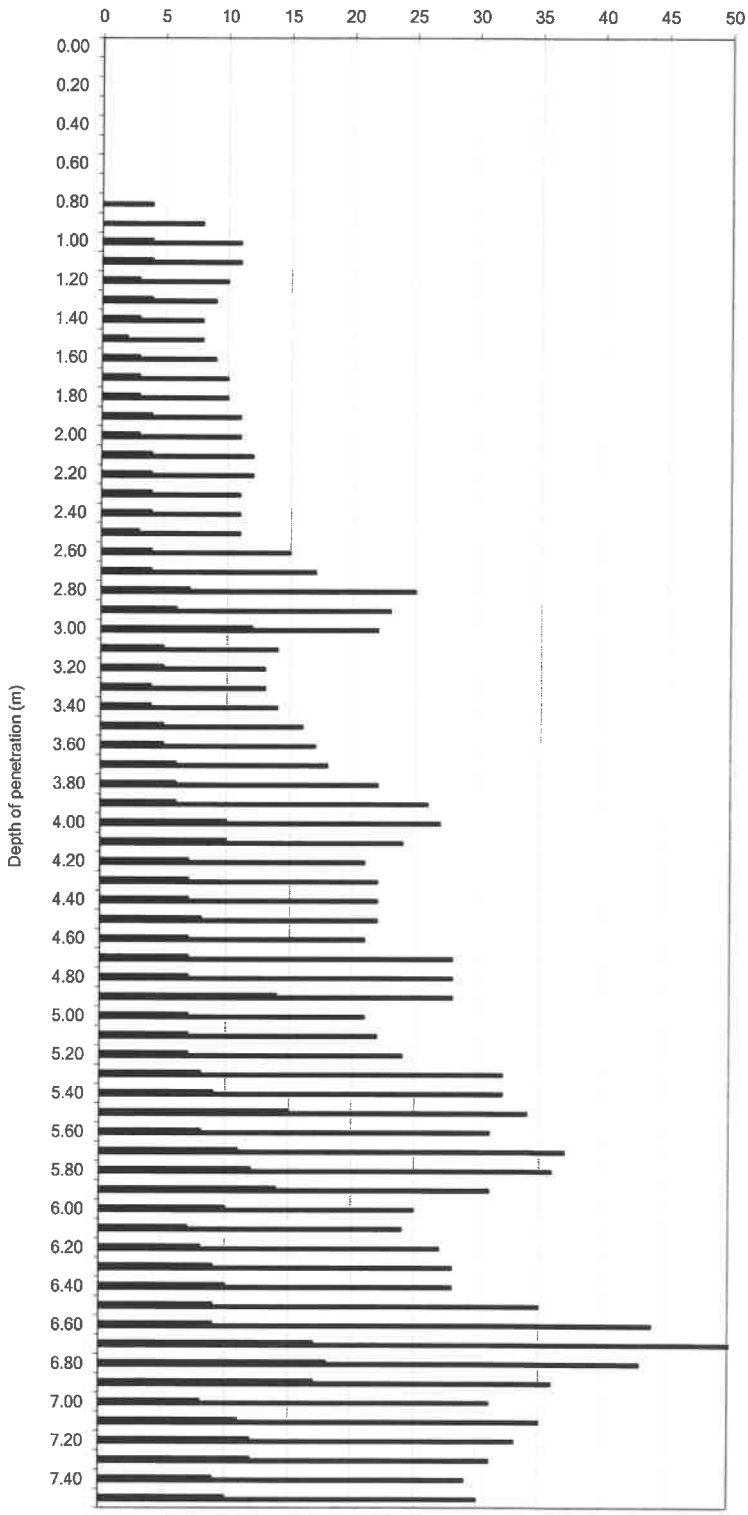
Sheet 1 of 1

e3p

Penetration Test Results			
Depth (m)	DPN_{100}	DPN_{300}	SPT N *
0.00	0	0	0
0.10	0	0	0
0.20	0	0	0
0.30	0	0	0
0.40	0	0	0
0.50	0	0	0
0.60	0	0	0
0.70	0	0	0
0.80	0	4	4
0.90	0	8	8
1.00	4	11	11
1.10	4	11	11
1.20	3	10	10
1.30	4	9	9
1.40	3	8	8
1.50	2	8	8
1.60	3	9	9
1.70	3	10	10
1.80	3	10	10
1.90	4	11	11
2.00	3	11	11
2.10	4	12	12
2.20	4	12	12
2.30	4	11	11
2.40	4	11	11
2.50	3	11	11
2.60	4	15	15
2.70	4	17	17
2.80	7	25	25
2.90	6	23	23
3.00	12	22	22
3.10	5	14	14
3.20	5	13	13
3.30	4	13	13
3.40	4	14	14
3.50	5	16	16
3.60	5	17	17
3.70	6	18	18
3.80	6	22	22
3.90	6	26	26
4.00	10	27	27
4.10	10	24	24
4.20	7	21	21
4.30	7	22	22
4.40	7	22	22
4.50	8	22	22
4.60	7	21	21
4.70	7	28	28
4.80	7	28	28
4.90	14	28	28
5.00	7	21	21
5.10	7	22	22
5.20	7	24	24
5.30	8	32	32
5.40	9	32	32
5.50	15	34	34
5.60	8	31	31
5.70	11	37	37
5.80	12	36	36
5.90	14	31	31
6.00	10	25	25
6.10	7	24	24
6.20	8	27	27
6.30	9	28	28
6.40	10	28	28
6.50	9	35	35
6.60	9	44	44
6.70	17	52	52
6.80	18	43	43
6.90	17	36	36
7.00	8	31	31
7.10	11	35	35
7.20	12	33	33
7.30	12	31	31
7.40	9	29	29
7.50	10	30	30

Hammer Mass: 63.5 kg Cone Dia: 50.5mm

Drop Height: 750 mm Test by: RJW



DPN_{100} values (shorter bars) & equivalent SPT values (longer bars)

General Remarks:

DPN_{100} = Dynamic penetration resistance for 100mm penetration.

DPN_{300} = Dynamic penetration resistance for 300mm penetration (ie: sum of 3 consecutive DPN_{100} values), starting at the depth given.

* Equivalent SPT N-values (for 300mm penetration) assumed to approximate the DPN_{300} values for dynamic probe "super-heavy" test (DPSH).

For dynamic probe "heavy" test (DPH), equivalent SPT N-values estimated using the theoretical relationship DPN_{300} = 1.5 SPT-N. [see Card,G.B., Roche,D.P. & Herbert,S.M., In Geol. Soc. Special Publication No 6, *Field Testing in Engineering Geology* (1990)]. SPT values are estimated and are for general guidance only.

Dynamic Probe Test Results Sheet

DP No: SHDP102

Site: **CHIPPING 4**

Job Number: **12-424**

Client: **Chadkirk Consulting**

Rig Type:

Date: 19th April 2018

Test Type: SHDP

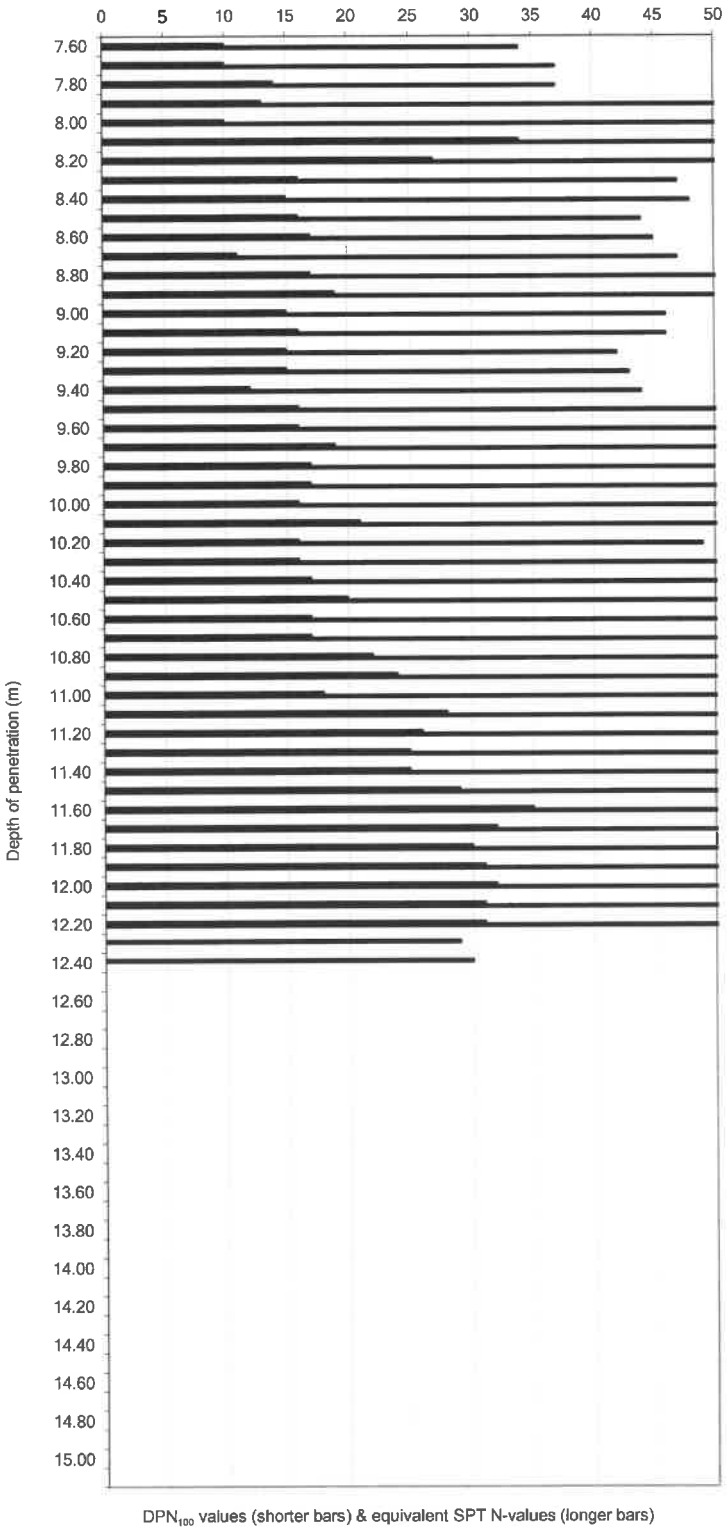
Final Depth: 5.00

Sheet 2 of 1

e3p

Penetration Test Results			
Depth (m)	DPN_{100}	DPN_{300}	SPT N *
7.60	10	34	34
7.70	10	37	37
7.80	14	37	37
7.90	13	57	57
8.00	10	71	71
8.10	34	77	77
8.20	27	58	58
8.30	16	47	47
8.40	15	48	48
8.50	16	44	44
8.60	17	45	45
8.70	11	47	47
8.80	17	51	51
8.90	19	50	50
9.00	15	46	46
9.10	16	46	46
9.20	15	42	42
9.30	15	43	43
9.40	12	44	44
9.50	16	51	51
9.60	16	52	52
9.70	19	53	53
9.80	17	50	50
9.90	17	54	54
10.00	16	53	53
10.10	21	53	53
10.20	16	49	49
10.30	16	53	53
10.40	17	54	54
10.50	20	54	54
10.60	17	56	56
10.70	17	63	63
10.80	22	64	64
10.90	24	70	70
11.00	18	72	72
11.10	28	79	79
11.20	26	76	76
11.30	25	79	79
11.40	25	89	89
11.50	29	96	96
11.60	35	97	97
11.70	32	93	93
11.80	30	93	93
11.90	31	94	94
12.00	32	94	94
12.10	31	91	91
12.20	31	90	90
12.30	29		
12.40	30		
12.50			
12.60			
12.70			
12.80			
12.90			
13.00			
13.10			
13.20			
13.30			
13.40			
13.50			
13.60			
13.70			
13.80			
13.90			
14.00			
14.10			
14.20			
14.30			
14.40			
14.50			
14.60			
14.70			
14.80			
14.90			
15.00			

Hammer Mass: 63.5 kg
Drop Height: 750 mm
Cone Dia: 50.5mm
Test by: RJW



DPN_{100} values (shorter bars) & equivalent SPT N-values (longer bars)

General Remarks:

DPN_{100} = Dynamic penetration resistance for 100mm penetration.

DPN_{300} = Dynamic penetration resistance for 300mm penetration (ie: sum of 3 consecutive DPN_{100} values), starting at the depth given.

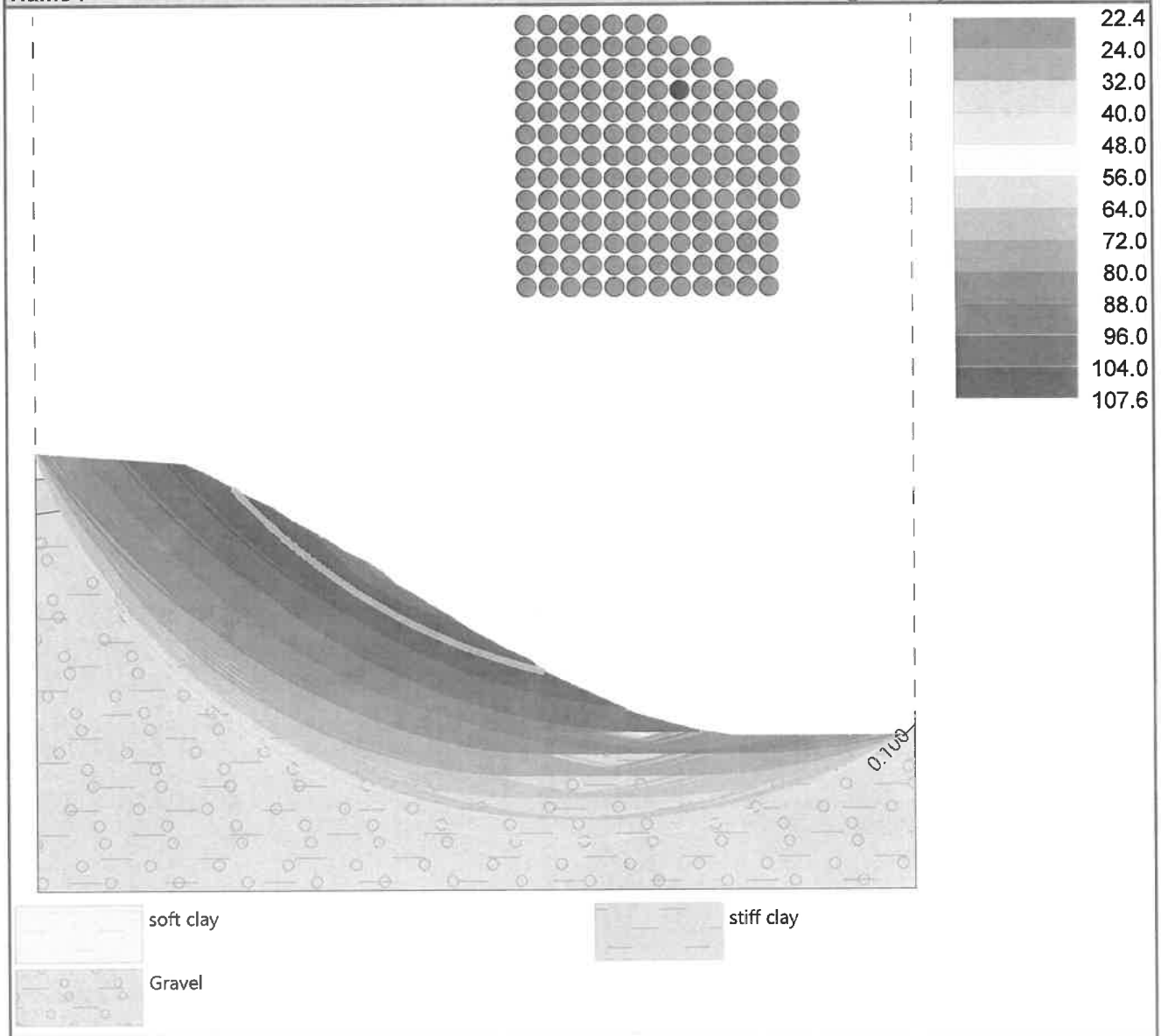
* Equivalent SPT N-values (for 300mm penetration) assumed to approximate the DPN_{300} values for dynamic probe "super-heavy" test (DPSH).

For dynamic probe "heavy" test (DPH), equivalent SPT N-values estimated using the theoretical relationship DPN_{300} = 1.5 SPT-N. [see Card,G.B., Roche,D.P. & Herbert,S.M., in Geol. Soc. Special Publication No 6, Field Testing in Engineering Geology (1990)]. SPT values are estimated and are for general guidance only.

Appendix D

Geo5 Outputs

Name : **Stage - analysis : 1 - 1**



Slip surface after grid search.

Slope stability verification (Bishop)
Combination 1

Sum of active forces : F_a = 183.62 kN/m
Sum of passive forces : F_p = 197.23 kN/m

Sliding moment : M_a = 4463.73 kNm/m
Resisting moment : M_p = 4794.64 kNm/m
Utilization : 93.1 %

Slope stability ACCEPTABLE

Combination 2

Sum of active forces : F_a = 153.62 kN/m
Sum of passive forces : F_p = 142.71 kN/m

Sliding moment : M_a = 4195.35 kNm/m
Resisting moment : M_p = 3897.55 kNm/m
Utilization : 107.6 %

Slope stability NOT ACCEPTABLE

Name : **Stage - analysis : 1 - 2**

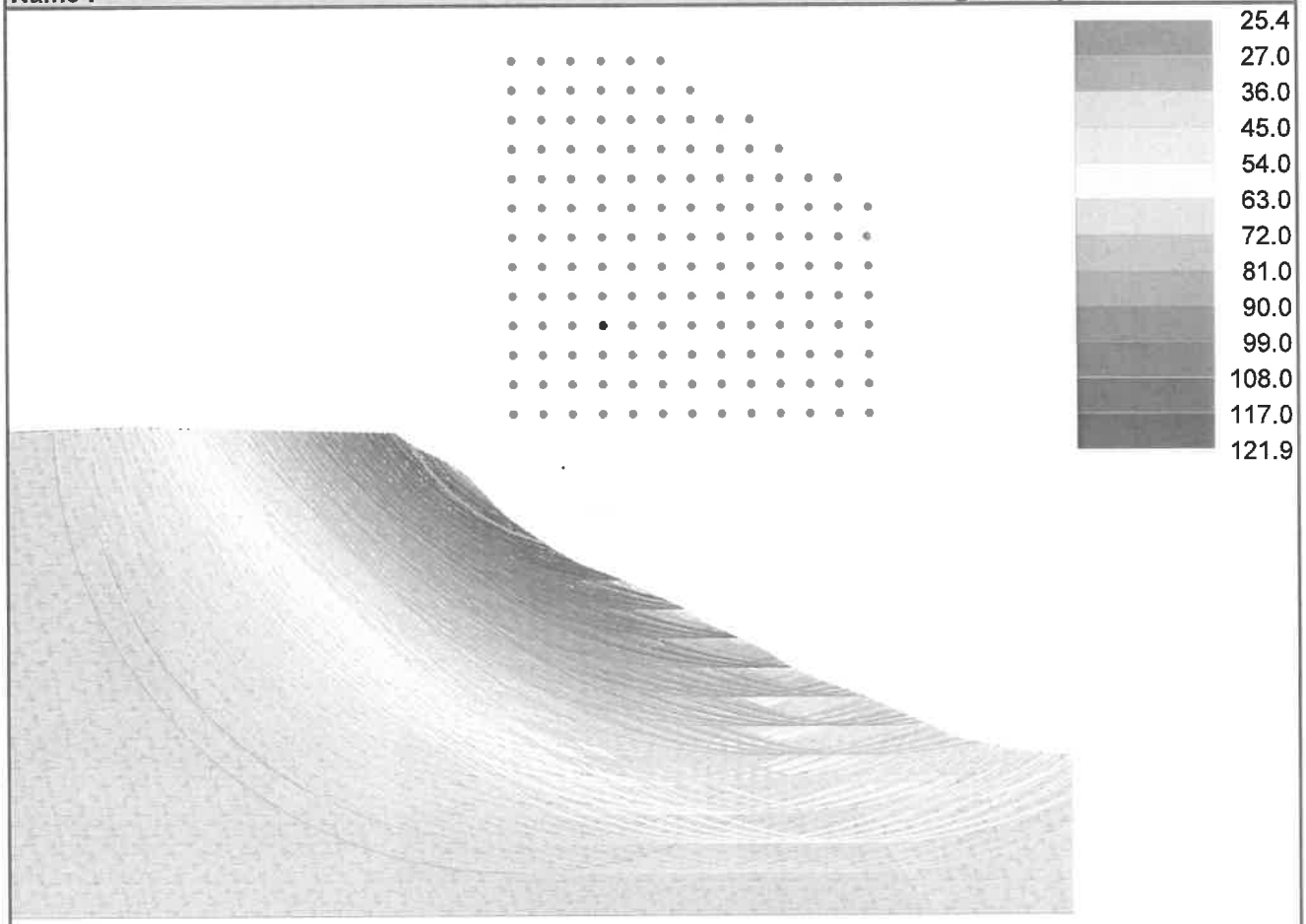
The slip surface after optimization.

Slope stability verification (Sarma)
Combination 1
Utilization : 91.1 %

Slope stability ACCEPTABLE
Combination 2
Utilization : 105.1 %

Slope stability NOT ACCEPTABLE
Optimized slip surface for : Combination 2

Name : **Stage - analysis : 1 - 1**



Gravel

Slip surface after grid search.

Slope stability verification (Bishop)

Combination 1

Sum of active forces : F_a = 28.94 kN/m
Sum of passive forces : F_p = 27.80 kN/m

Sliding moment : M_a = 338.29 kNm/m
Resisting moment : M_p = 324.96 kNm/m
Utilization : 104.1 %

Slope stability NOT ACCEPTABLE

Combination 2

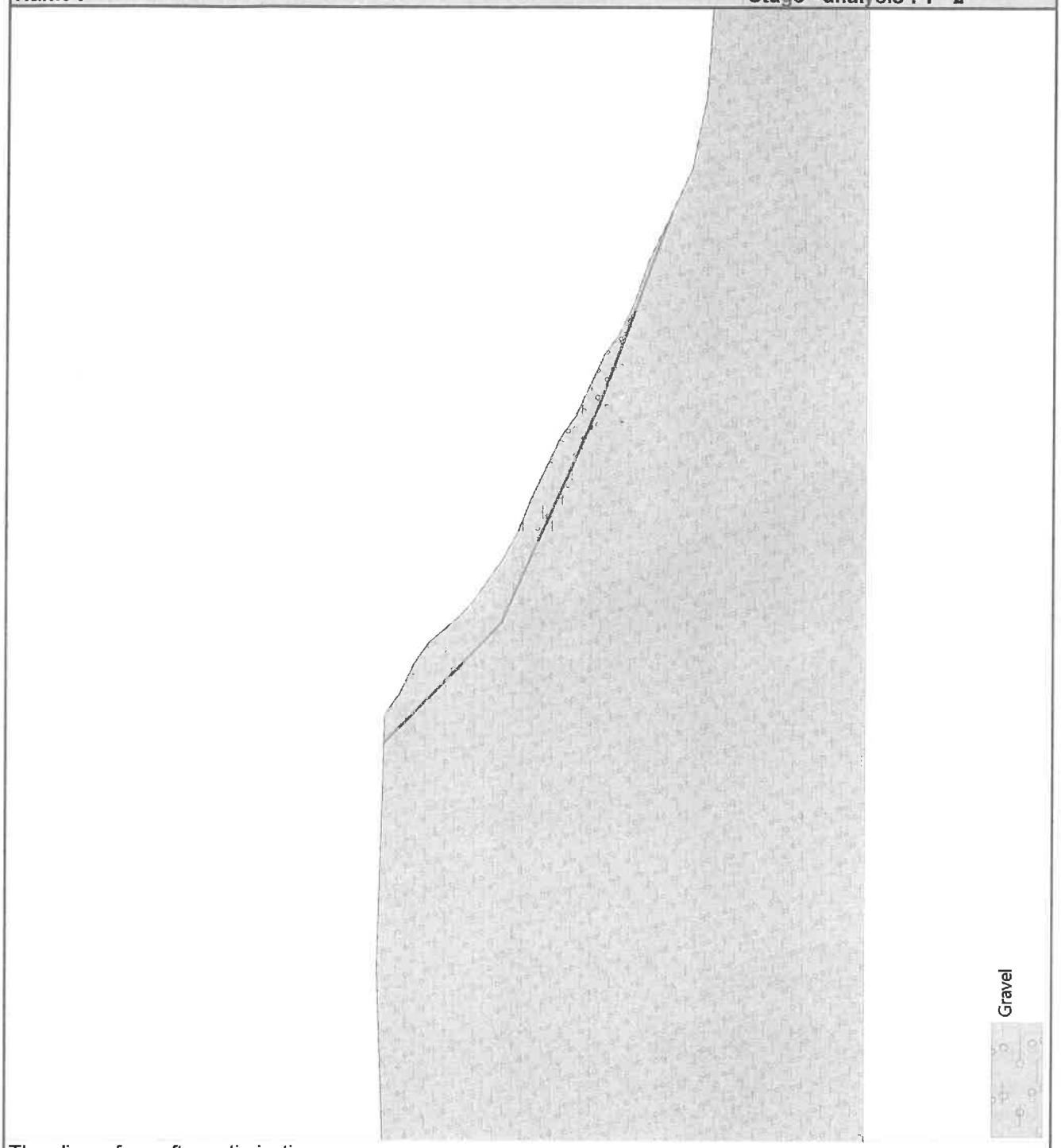
Sum of active forces : F_a = 31.71 kN/m
Sum of passive forces : F_p = 26.02 kN/m

Sliding moment : M_a = 243.85 kNm/m
Resisting moment : M_p = 200.11 kNm/m
Utilization : 121.9 %

Slope stability NOT ACCEPTABLE

Name :

Stage - analysis : 1 - 2



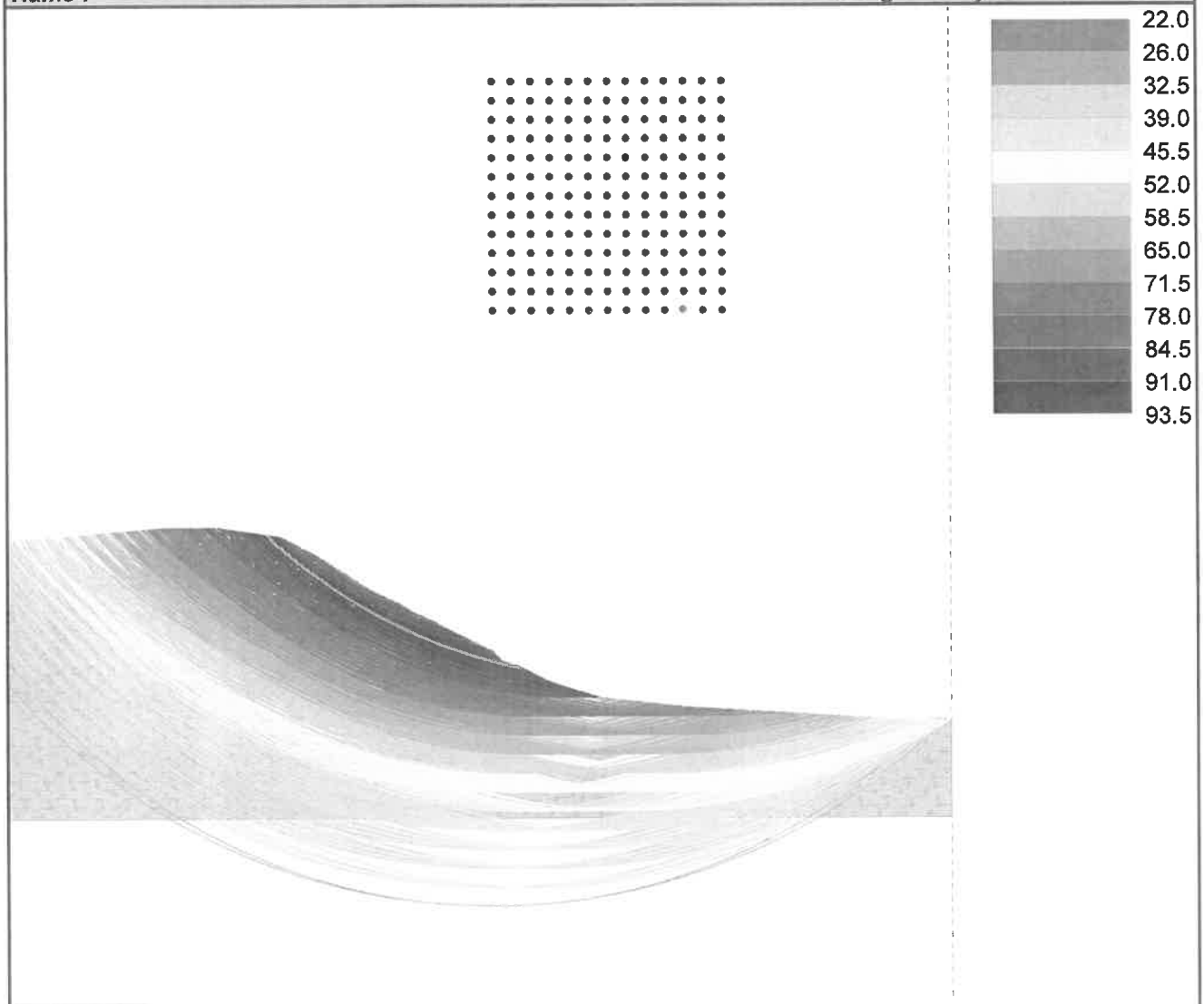
The slip surface after optimization.

Slope stability verification (Sarma)
Combination 1
Utilization : 88.1 %

Slope stability ACCEPTABLE
Combination 2
Utilization : 99.6 %

Slope stability ACCEPTABLE
Optimized slip surface for : Combination 2

Name : **Stage - analysis : 1 - 1**



Slip surface after grid search.

Slope stability verification (Bishop)
Combination 1

Sum of active forces : F_a = 160.79 kN/m
Sum of passive forces : F_p = 200.26 kN/m

Sliding moment : M_a = 4085.61 kNm/m
Resisting moment : M_p = 5088.53 kNm/m
Utilization : 80.3 %

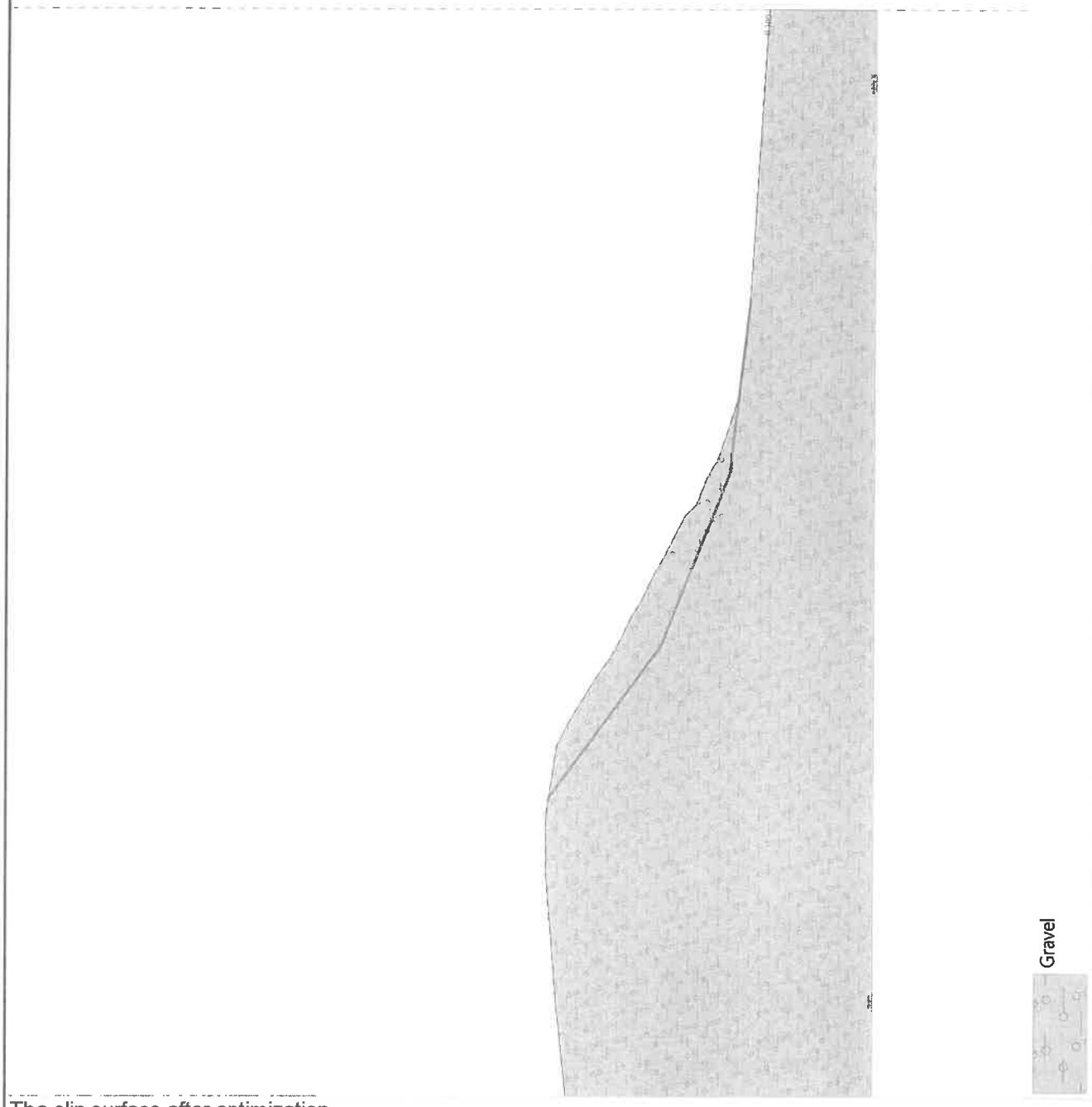
Slope stability ACCEPTABLE
Combination 2

Sum of active forces : F_a = 115.58 kN/m
Sum of passive forces : F_p = 123.64 kN/m

Sliding moment : M_a = 3167.96 kNm/m
Resisting moment : M_p = 3388.87 kNm/m
Utilization : 93.5 %

Slope stability ACCEPTABLE

Name : **Stage - analysis : 1 - 2**



The slip surface after optimization.

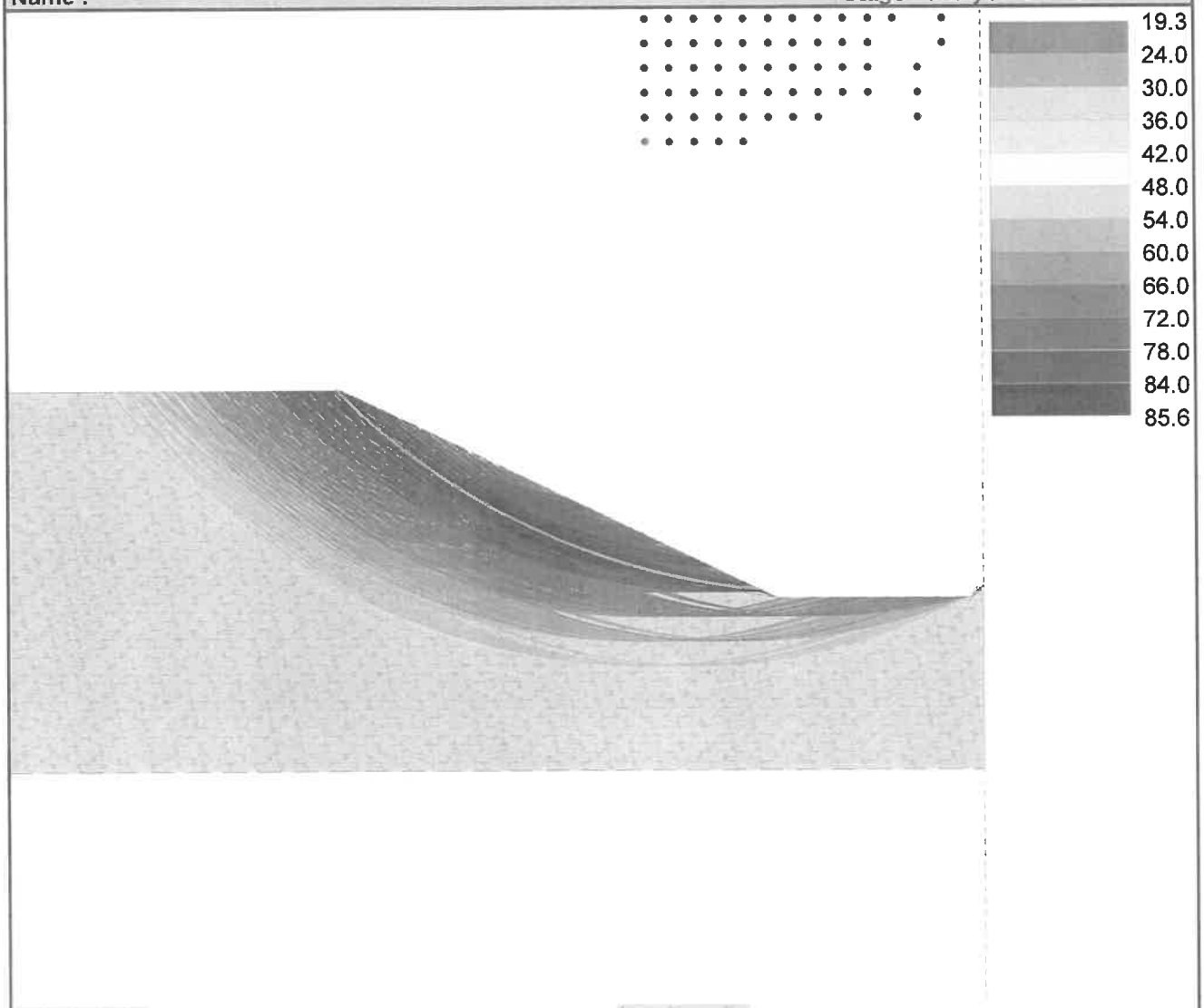
Slope stability verification (Sarma)
Combination 1
Utilization : 76.8 %

Slope stability ACCEPTABLE
Combination 2
Utilization : 87.3 %

Slope stability ACCEPTABLE
Optimized slip surface for : Combination 2

Name :

Stage - analysis : 3 - 1



Slip surface after grid search.

Slope stability verification (Bishop)
Combination 1

Sum of active forces : F_a = 222.82 kN/m
Sum of passive forces : F_p = 303.39 kN/m

Sliding moment : M_a = 5416.75 kNm/m
Resisting moment : M_p = 7375.29 kNm/m
Utilization : 73.4 %

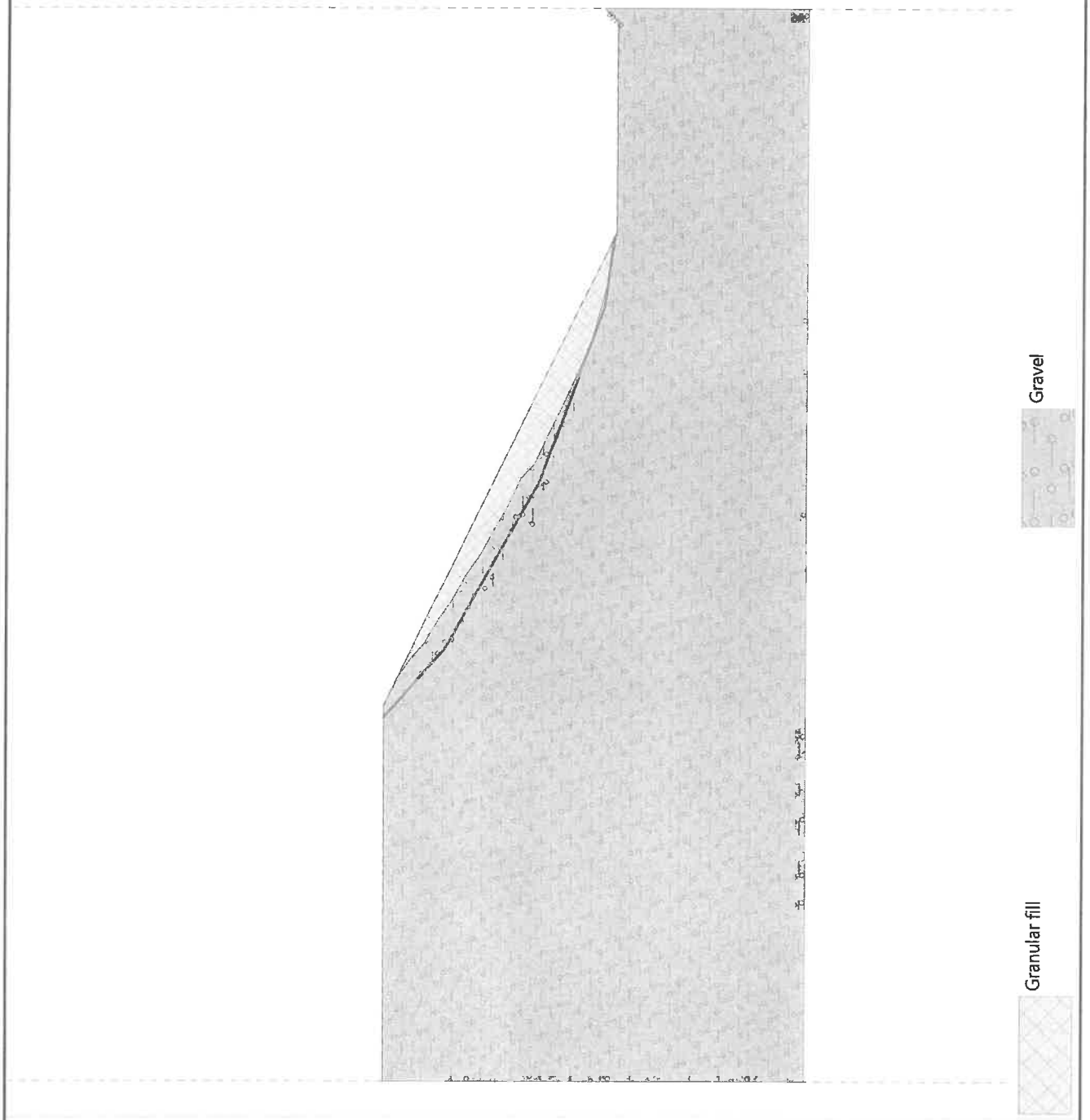
Slope stability ACCEPTABLE
Combination 2

Sum of active forces : F_a = 193.75 kN/m
Sum of passive forces : F_p = 226.39 kN/m

Sliding moment : M_a = 5291.28 kNm/m
Resisting moment : M_p = 6182.72 kNm/m
Utilization : 85.6 %

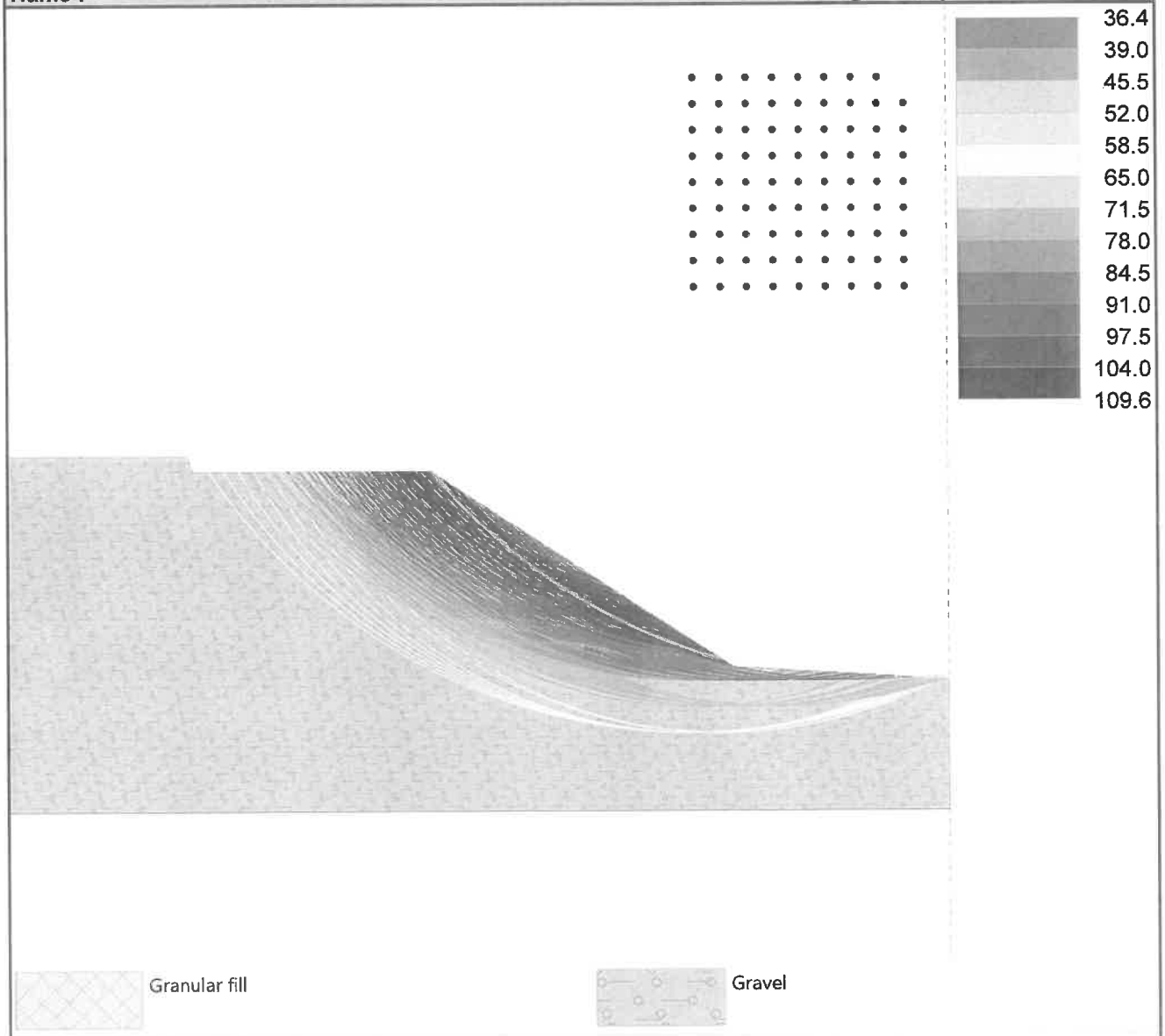
Slope stability ACCEPTABLE

Name : **Stage - analysis : 3 - 2**



The slip surface after optimization.
Slope stability verification (Sarma)
Combination 1
Utilization : 74.0 %
Slope stability ACCEPTABLE
Combination 2
Utilization : 86.0 %
Slope stability ACCEPTABLE
Optimized slip surface for : Combination 2

Name : **Stage - analysis : 3 - 1**



Slip surface after grid search.

Slope stability verification (Bishop)

Combination 1

Sum of active forces : F_a = 123.54 kN/m
Sum of passive forces : F_p = 130.50 kN/m

Sliding moment : M_a = 2236.21 kNm/m
Resisting moment : M_p = 2362.25 kNm/m
Utilization : 94.7 %

Slope stability ACCEPTABLE

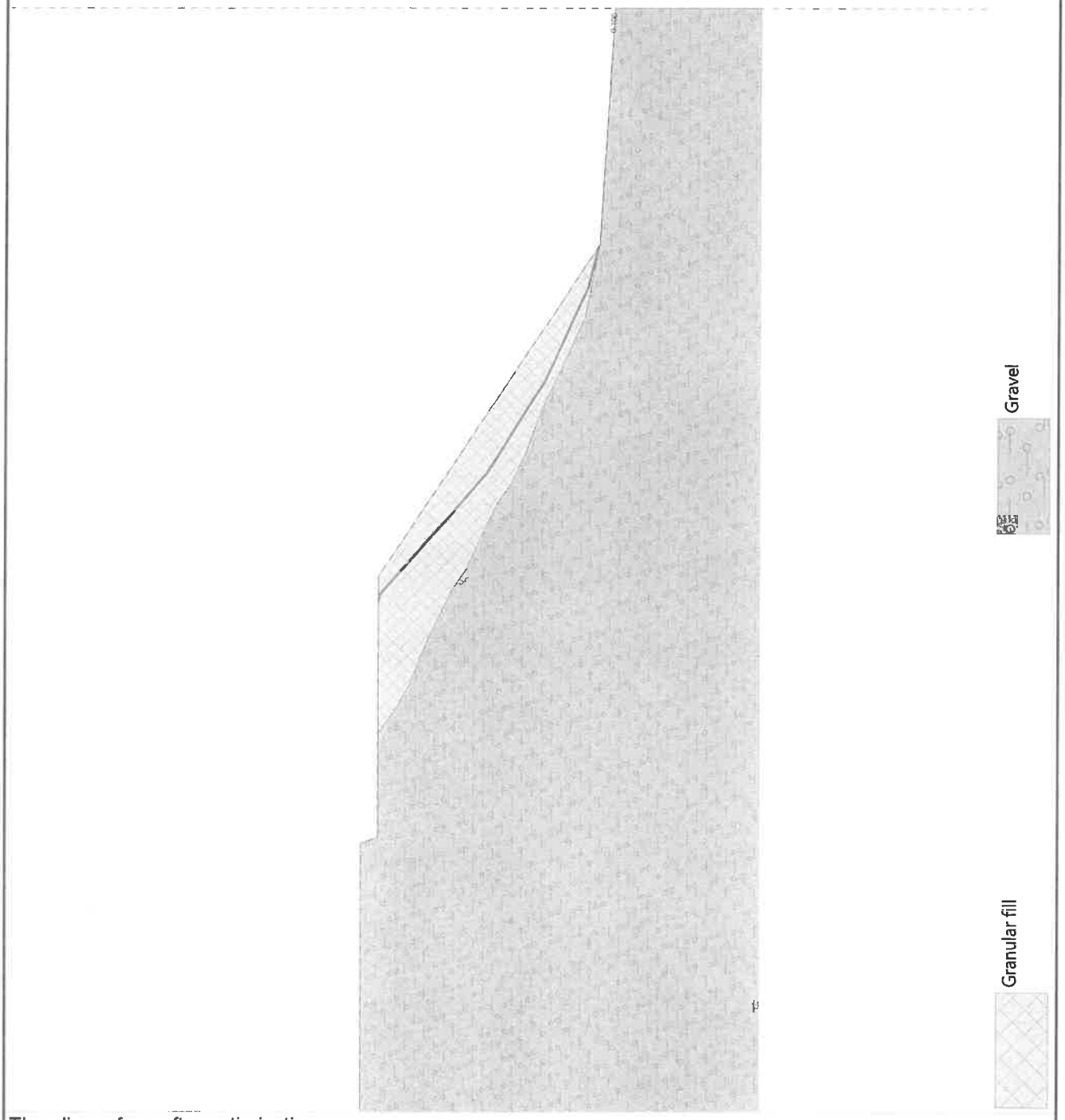
Combination 2

Sum of active forces : F_a = 97.59 kN/m
Sum of passive forces : F_p = 89.07 kN/m

Sliding moment : M_a = 2156.83 kNm/m
Resisting moment : M_p = 1968.47 kNm/m
Utilization : 109.6 %

Slope stability NOT ACCEPTABLE

Name : **Stage - analysis : 3 - 2**



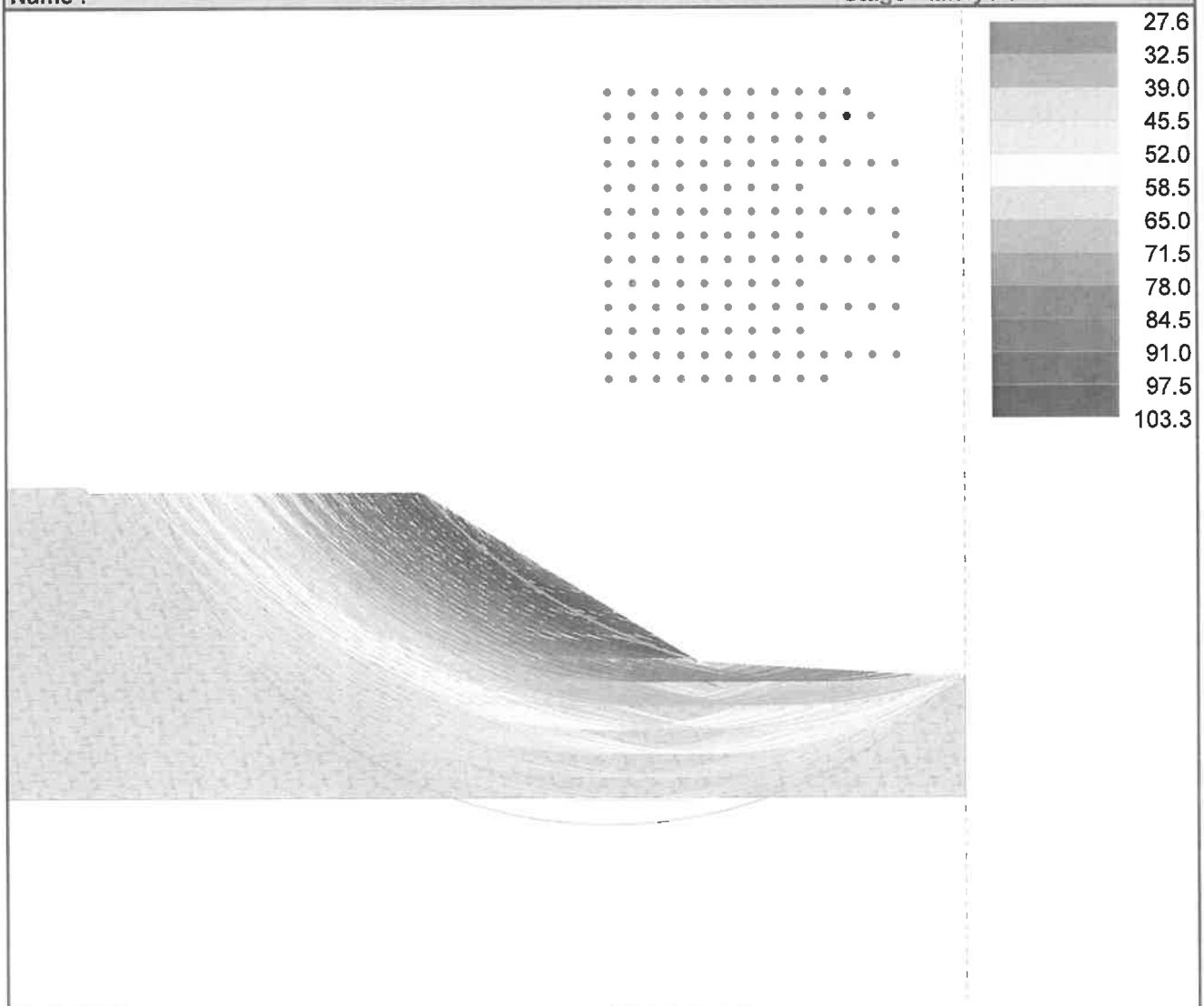
The slip surface after optimization.

Slope stability verification (Sarma)
Combination 1
Utilization : 94.9 %

Slope stability ACCEPTABLE
Combination 2
Utilization : 109.6 %

Slope stability NOT ACCEPTABLE
Optimized slip surface for : Combination 2

Name : **Stage - analysis : 3 - 1**



Slip surface after grid search.

Slope stability verification (Bishop)
Combination 1

Sum of active forces : F_a = 137.00 kN/m
Sum of passive forces : F_p = 152.62 kN/m

Sliding moment : M_a = 2428.99 kNm/m
Resisting moment : M_p = 2705.91 kNm/m
Utilization : 89.8 %

Slope stability ACCEPTABLE

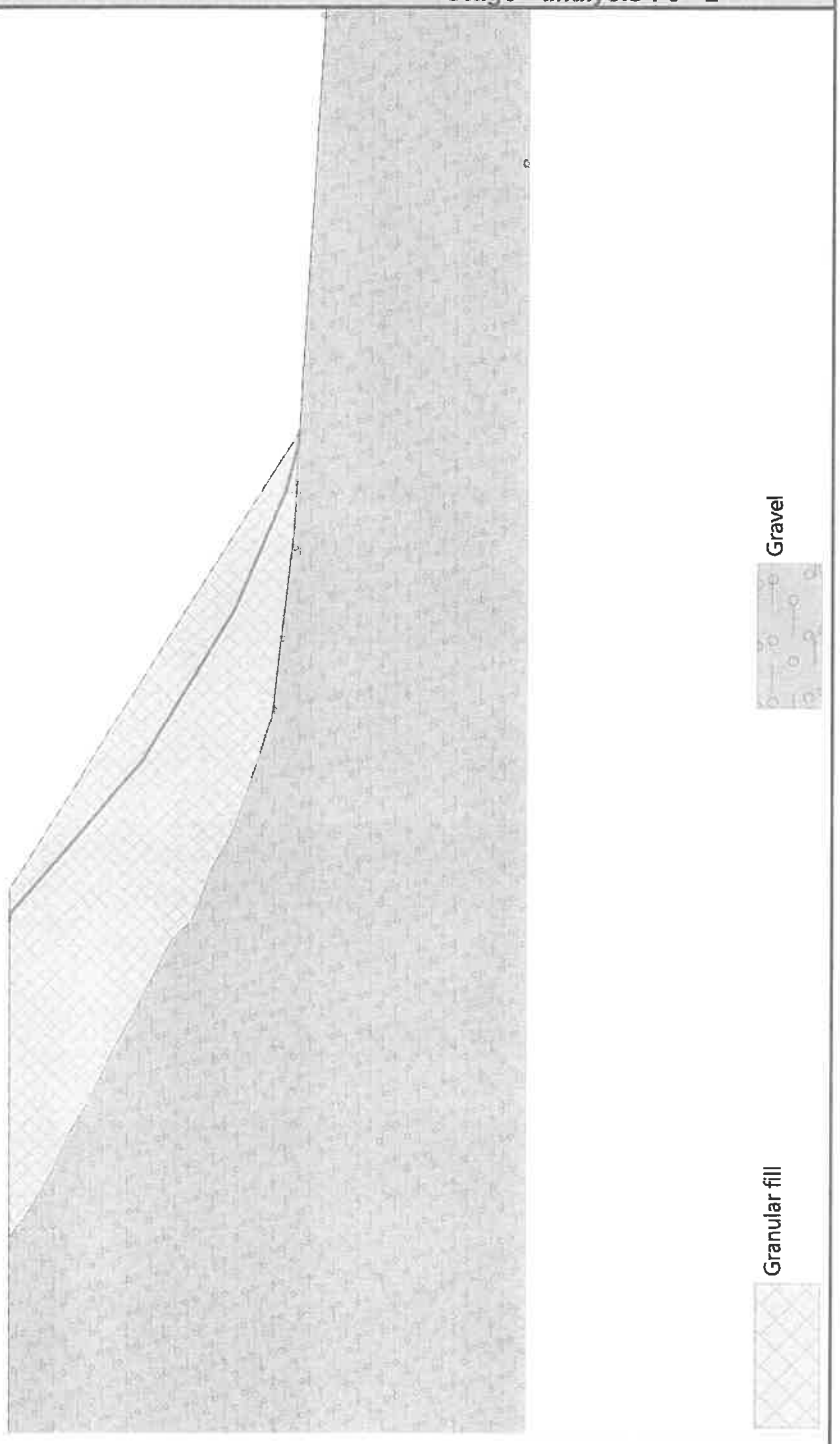
Combination 2

Sum of active forces : F_a = 86.30 kN/m
Sum of passive forces : F_p = 83.57 kN/m

Sliding moment : M_a = 2047.87 kNm/m
Resisting moment : M_p = 1983.01 kNm/m
Utilization : 103.3 %

Slope stability NOT ACCEPTABLE

Name : **Stage - analysis : 3 - 2**



The slip surface after optimization.

Slope stability verification (Sarma)
Combination 1
Utilization : 89.8 %

Slope stability ACCEPTABLE
Combination 2
Utilization : 105.2 %

Slope stability NOT ACCEPTABLE
Optimized slip surface for : Combination 2

Slope stability analysis

Input data

Project

Task : B B
Customer : Hodson Homes
Author : JS
Date : 01/06/2022
Project ID : Chipping
Project number : 80789

Settings

Standard - EN 1997 - DA1

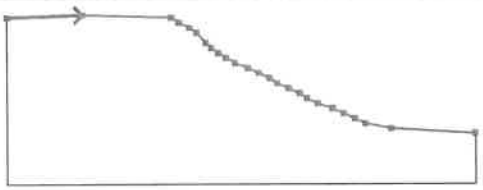
Stability analysis

Verification methodology : according to EN 1997
Earthquake analysis : Standard
Design approach : 1 - reduction of actions and soil parameters

Partial factors on actions (A)					
Permanent design situation					
		Combination 1		Combination 2	
		Unfavourable	Favourable	Unfavourable	Favourable
Permanent actions :	γ_G =	1.35 [–]	1.00 [–]	1.00 [–]	1.00 [–]
Variable actions :	γ_Q =	1.50 [–]	0.00 [–]	1.30 [–]	0.00 [–]
Water load :	γ_w =	1.35 [–]		1.00 [–]	

Partial factors for soil parameters (M)			
Permanent design situation			
		Combination 1	Combination 2
Partial factor on internal friction :	γ_ϕ =	1.00 [–]	1.25 [–]
Partial factor on effective cohesion :	γ_c =	1.00 [–]	1.25 [–]
Partial factor on undrained shear strength :	γ_{cu} =	1.00 [–]	1.40 [–]

Interface

No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
1		0.00	131.50	7.41	131.75	16.20	131.50
		16.92	131.00	18.00	130.50	18.72	130.00
		19.62	129.00	20.16	128.50	20.88	128.00
		21.60	127.50	22.50	127.00	23.76	126.50
		24.84	126.00	25.92	125.50	26.64	125.00
		27.72	124.50	28.80	124.00	29.52	123.50
		30.60	123.00	32.04	122.50	33.12	122.00
		34.20	121.50	35.28	121.00	37.80	120.50
		46.00	120.00				

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [kPa]	γ [kN/m^3]
1	Gravel		36.00	1.00	20.00
2	soft clay		26.00	2.00	19.00
3	stiff clay		28.00	2.00	20.00
4	Granular fill		36.00	1.00	20.00

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [kN/m^3]	γ_s [kN/m^3]	n [–]
1	Gravel		21.00		
2	soft clay		19.00		
3	stiff clay		20.00		
4	Granular fill		21.00		

Soil parameters

Gravel

Unit weight : γ = 20.00 kN/m^3
Stress-state : effective
Angle of internal friction : φ_{ef} = 36.00 °
Cohesion of soil : c_{ef} = 1.00 kPa
Saturated unit weight : γ_{sat} = 21.00 kN/m^3

soft clay

Unit weight : γ = 19.00 kN/m^3
Stress-state : effective
Angle of internal friction : φ_{ef} = 26.00 °
Cohesion of soil : c_{ef} = 2.00 kPa
Saturated unit weight : γ_{sat} = 19.00 kN/m^3

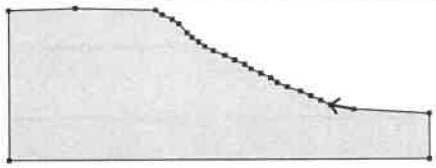
stiff clay

Unit weight : γ = 20.00 kN/m^3

Stress-state : effective
Angle of internal friction : φ_{ef} = 28.00 °
Cohesion of soil : c_{ef} = 2.00 kPa
Saturated unit weight : γ_{sat} = 20.00 kN/m^3

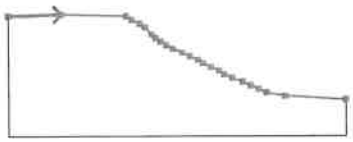
Granular fill
Unit weight : γ = 20.00 kN/m^3
Stress-state : effective
Angle of internal friction : φ_{ef} = 36.00 °
Cohesion of soil : c_{ef} = 1.00 kPa
Saturated unit weight : γ_{sat} = 21.00 kN/m^3

Assigning and surfaces

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		37.80	120.50	35.28	121.00	Gravel
		34.20	121.50	33.12	122.00	
		32.04	122.50	30.60	123.00	
		29.52	123.50	28.80	124.00	
		27.72	124.50	26.64	125.00	
		25.92	125.50	24.84	126.00	
		23.76	126.50	22.50	127.00	
		21.60	127.50	20.88	128.00	
		20.16	128.50	19.62	129.00	
		18.72	130.00	18.00	130.50	
		16.92	131.00	16.20	131.50	
		7.41	131.75	0.00	131.50	
		0.00	115.00	46.00	115.00	
		46.00	120.00			

Water

Water type : Coefficient Ru

No.	Interface Ru location	Coordinates of interface Ru points [m]						Coeff. Ru [–]
		x	z	x	z	x	z	
1		0.00	131.50	7.41	131.75	16.20	131.50	0.100
		16.92	131.00	18.00	130.50	18.72	130.00	
		19.62	129.00	20.16	128.50	20.88	128.00	
		21.60	127.50	22.50	127.00	23.76	126.50	
		24.84	126.00	25.92	125.50	26.64	125.00	
		27.72	124.50	28.80	124.00	29.52	123.50	
		30.60	123.00	32.04	122.50	33.12	122.00	
		34.20	121.50	35.28	121.00	37.80	120.50	
		46.00	120.00					

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 1)

Analysis 1 (stage 1)

Circular slip surface

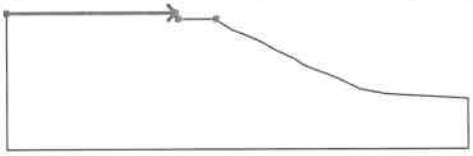
Slip surface parameters					
Center :	x =	26.31 [m]	Angles :	α_1 =	-52.93 [°]
	z =	139.15 [m]		α_2 =	-18.40 [°]
Radius :	R =	12.69 [m]			
Specified slip surface.					

Slope stability verification (Bishop)

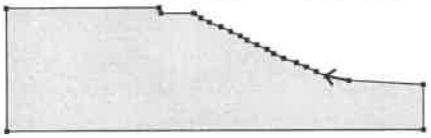
Analysis has not been performed.

Input data (Stage of construction 2)

Earth cut

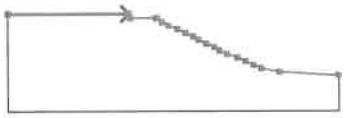
No.	Cut location	Coordinates of cut points [m]					
		x	z	x	z	x	z
1		0.00	128.65	17.00	128.65	17.20	128.05
		21.00	128.05				

Assigning and surfaces

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		37.80	120.50	35.28	121.00	Gravel
		34.20	121.50	33.12	122.00	
		32.04	122.50	30.60	123.00	
		29.52	123.50	28.80	124.00	
		27.72	124.50	26.64	125.00	
		25.92	125.50	24.84	126.00	
		23.76	126.50	22.50	127.00	
		21.60	127.50	20.88	128.00	
		20.81	128.05	17.20	128.05	
		17.00	128.65	0.00	128.65	
		0.00	115.00	46.00	115.00	
		46.00	120.00			

Water

Water type : Coefficient Ru

No.	Interface Ru location	Coordinates of interface Ru points [m]						Coeff. Ru [–]
		x	z	x	z	x	z	
1		0.00	128.65	17.00	128.65	17.20	128.05	0.100
		20.81	128.05	20.88	128.00	21.60	127.50	
		22.50	127.00	23.76	126.50	24.84	126.00	
		25.92	125.50	26.64	125.00	27.72	124.50	
		28.80	124.00	29.52	123.50	30.60	123.00	
		32.04	122.50	33.12	122.00	34.20	121.50	
		35.28	121.00	37.80	120.50	46.00	120.00	

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 2)

Analysis 1 (stage 2)

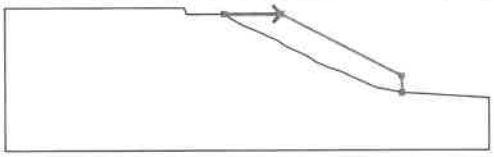
Circular slip surface

Slip surface parameters					
Center :	x =	26.31 [m]	Angles :	α_1 =	-28.99 [°]
	z =	139.15 [m]		α_2 =	-18.40 [°]
Radius :	R =	12.69 [m]			
Specified slip surface.					

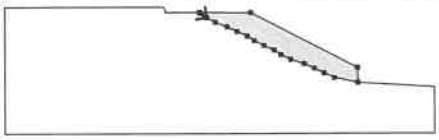
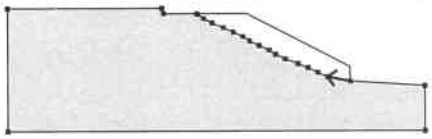
Slope stability verification (Bishop)
Analysis has not been performed.

Input data (Stage of construction 3)

Embankment interface

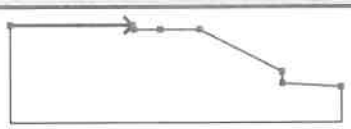
No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
1		20.81	128.05	26.28	128.04	37.75	122.12
		37.80	120.50				

Assigning and surfaces

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		20.88	128.00	21.60	127.50	Granular fill
		22.50	127.00	23.76	126.50	
		24.84	126.00	25.92	125.50	
		26.64	125.00	27.72	124.50	
		28.80	124.00	29.52	123.50	
		30.60	123.00	32.04	122.50	
		33.12	122.00	34.20	121.50	
		35.28	121.00	37.80	120.50	
		37.75	122.12	26.28	128.04	
		20.81	128.05			
2		37.80	120.50	35.28	121.00	Gravel
		34.20	121.50	33.12	122.00	
		32.04	122.50	30.60	123.00	
		29.52	123.50	28.80	124.00	
		27.72	124.50	26.64	125.00	
		25.92	125.50	24.84	126.00	
		23.76	126.50	22.50	127.00	
		21.60	127.50	20.88	128.00	
		20.81	128.05	17.20	128.05	
		17.00	128.65	0.00	128.65	
		0.00	115.00	46.00	115.00	
		46.00	120.00			

Water

Water type : Coefficient Ru

No.	Interface Ru location	Coordinates of interface Ru points [m]						Coeff. Ru [–]
		x	z	x	z	x	z	
1		0.00	128.65	17.00	128.65	17.20	128.05	0.100
		20.81	128.05	26.28	128.04	37.75	122.12	
		37.80	120.50	46.00	120.00			

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 3)

Analysis 1 (stage 3)

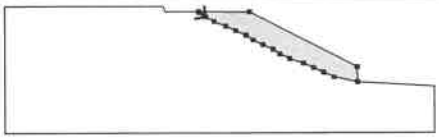
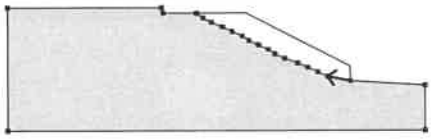
Circular slip surface

Slip surface parameters						
Center :	x =	28.31	[m]	Angles :	α_1 =	-44.97 [°]
	z =	139.15	[m]		α_2 =	19.18 [°]
Radius :	R =	15.69	[m]			
Specified slip surface.						

Slope stability verification (Bishop)
Analysis has not been performed.

Input data (Stage of construction 4)

Assigning and surfaces

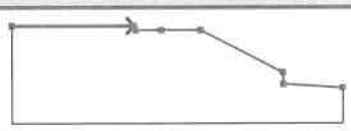
No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		20.88	128.00	21.60	127.50	Granular fill
		22.50	127.00	23.76	126.50	
		24.84	126.00	25.92	125.50	
		26.64	125.00	27.72	124.50	
		28.80	124.00	29.52	123.50	
		30.60	123.00	32.04	122.50	
		33.12	122.00	34.20	121.50	
		35.28	121.00	37.80	120.50	
		37.75	122.12	26.28	128.04	
		20.81	128.05			
2		37.80	120.50	35.28	121.00	Gravel
		34.20	121.50	33.12	122.00	
		32.04	122.50	30.60	123.00	
		29.52	123.50	28.80	124.00	
		27.72	124.50	26.64	125.00	
		25.92	125.50	24.84	126.00	
		23.76	126.50	22.50	127.00	
		21.60	127.50	20.88	128.00	
		20.81	128.05	17.20	128.05	
		17.00	128.65	0.00	128.65	
		0.00	115.00	46.00	115.00	
		46.00	120.00			

Reinforcements

No.	Reinforcement new	Point to the left x [m]	Point to the left z [m]	Point to the right x [m]	Point to the right z [m]	Length L [m]	Strength R_t [kN/m]	Pull out resist.	End of reinf.
1	Yes	34.20	121.50	37.80	121.50	3.60	40.00	C = 0.70	Free
2	Yes	32.23	122.50	36.80	122.50	4.57	40.00	C = 0.70	Free
3	Yes	29.67	123.50	35.00	123.50	5.33	40.00	C = 0.70	Free
4	Yes	27.86	124.50	33.00	124.50	5.14	40.00	C = 0.70	Free
5	Yes	25.89	125.50	30.50	125.50	4.61	40.00	C = 0.70	Free
6	Yes	23.82	126.50	28.65	126.50	4.83	40.00	C = 0.70	Free
7	Yes	21.69	127.50	27.06	127.50	5.37	40.00	C = 0.80	Free
8	Yes	33.71	121.94	37.75	122.01	4.04	40.00	C = 0.70	Free
9	Yes	36.49	121.00	37.65	120.96	1.16	185.00	C = 0.80	Free

Water

Water type : Coefficient Ru

No.	Interface Ru location	Coordinates of interface Ru points [m]						Coeff. Ru [–]
		x	z	x	z	x	z	
1		0.00	128.65	17.00	128.65	17.20	128.05	0.100
		20.81	128.05	26.28	128.04	37.75	122.12	
		37.80	120.50	46.00	120.00			

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 4)

Analysis 1 (stage 4)

Circular slip surface

Slip surface parameters					
Center :	x =	38.27 [m]	Angles :	α_1 =	-56.71 [°]
	z =	137.53 [m]		α_2 =	6.33 [°]
Radius :	R =	17.28 [m]			
Specified slip surface.					

Slope stability verification (Bishop)
Analysis has not been performed.

Analysis 2 (stage 4)

Circular slip surface

Slip surface parameters					
Center :	x =	39.77 [m]	Angles :	α_1 =	-50.68 [°]
	z =	141.53 [m]		α_2 =	3.74 [°]
Radius :	R =	21.28 [m]			
Slip surface after grid search.					

Reinforcement bearing capacity

Combination 1

Reinforcement	Bearing capacity [kN/m]
1	0.00
2	0.00
3	0.00
4	0.00
5	0.00
6	17.84
7	16.11
8	0.00
9	0.00

Combination 2

Reinforcement	Bearing capacity [kN/m]
1	0.00
2	0.00
3	0.00
4	0.00
5	0.00
6	12.39
7	11.81
8	0.00
9	0.00

Slope stability verification (Bishop)
Combination 1

Sum of active forces : F_a = 395.55 kN/m
Sum of passive forces : F_p = 568.33 kN/m

Sliding moment : M_a = 7824.02 kNm/m
Resisting moment : M_p = 11241.57 kNm/m
Utilization : 69.6 %

Slope stability ACCEPTABLE

Combination 2

Sum of active forces : F_a = 347.62 kN/m
Sum of passive forces : F_p = 435.41 kN/m

Sliding moment : M_a = 7397.29 kNm/m
Resisting moment : M_p = 9265.48 kNm/m
Utilization : 79.8 %

Slope stability ACCEPTABLE

JS

Name : **Stage : 4**